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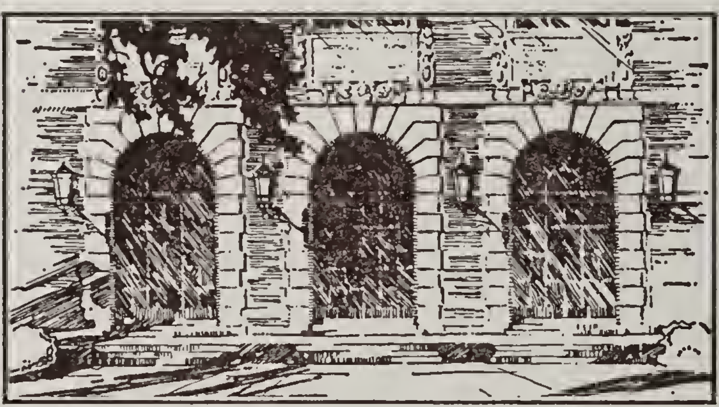

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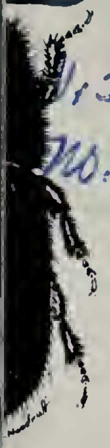

THE
COLEOPTERISTS
BULLETIN

304

AN INTERNATIONAL JOURNAL DEVOTED TO THE STUDY OF BEETLES

Volume 30, No. 1 **March, 1976**

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The following exceptions are noted: 1) all geographical names are to be spelled out, 2) use words, not symbols, for male and female, 3) use numerals throughout, except to begin a sentence, 4) entomology, -ical, -ist, etc. are to be abbreviated Ent. in literature citations.

Specimen label data should be listed in the following manner: MEXICO: State of Veracruz, Fortin de las Flores, 10-VIII-70, I. B. Jones, under bark of **Pinus moctezumae**, 7000ft. [USNM] (2). The number in parentheses indicates the number of specimens. Geographical names are listed in order with largest units first, with states,

(Continued inside back cover)

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APPLICATION OF A COMPUTERIZED GENERAL PURPOSE INFORMATION MANAGEMENT SYSTEM (SELGEM) TO A NATURAL HISTORY RESEARCH DATA BANK (COLEOPTERA: CARABIDAE)

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Smithsonian Institution, Washington DC 20560

ABSTRACT

Natural history data can be computerized to aid the systematics researcher by rearranging data for synthesis and analysis and in preparation of manuscripts. This paper describes the processes of data capture in the field and the work flow procedures to get this data onto computer readable magnetic tape and into a data bank. Field note standardized format is exemplified and discussed. Sixty-two data categories (data elements) are defined and discussed. This system was designed for use in a Central American Ground Beetle Faunal Study (Coleoptera: Carabidae), but can easily be adapted to other organisms. SELGEM, a general purpose information management system, is used. The data resources for the Faunal Study are field notes, specimen labels, specimens, and literature; the processes of literature data capture will be described elsewhere.

INTRODUCTION

Computer technology to aid systematists in accumulating, organizing, and evaluating the massive quantity of data with which they need to work has been available for several years. Data are from sources such as specimens, specimen labels, field notes, and literature. By using a computer, data only need be accumulated once if originally entered correctly for output. Once accumulated, and if appropriate computer programs are available, the computer can permute these data into lists, maps, indices, camera ready copy, graphs, etc. Printed copies of extracted and/or organized data (in any combination) can be used to assist systematists in the analytical and synthetic portions of their work, as a working or final report, for reference, or can be sent to colleagues.

Computer technology can aid the systematist, but the systematist must recognize the restrictions which computer technology entails; computer technology is not capable of organizing unstructured, nonconsistent raw data. *"If there is any one lesson to be learned from a data-banking experience, it is that a high premium should be placed on entering the data correctly in the first place, down to the finest detail in formatting, spacing, spelling, abbreviating and punctuating"* (Shetler 1974). Computer technology does not eliminate manual hours, but needs additional manual hours for specimen data preparation, as well as time for editing computer processed data. (See Shetler 1974 for a "devil's advocate" approach to computer technology as applied to biological data banking). If systematists have available the experience from other studies, they will be able to begin each subsequent study at a higher, more refined level; or if the previous study's level of refinement is applied, the data can be more quickly built into a meaningful data base.

For several years, the NMNH (Smithsonian Institution) has been involved in the development and use of procedures for computerization of data contained in systematic collections (Squires 1966, 1970; Manning 1969; Gautier 1974). The computer system developed at the Smithsonian to incorporate computer technology with museum needs is SELGEM, a general purpose information management system[1] (Creighton and Crockett 1971; Creighton, Packard, and Linn 1972; Creighton and Packard 1974; Chenhall 1975; Creighton and Robinson 1975; R. Creighton, P. Packard, and J. J. Crockett, unpublished manuscript).[2] Some advantages of SELGEM are that data records can be entered in fixed or variable length formats; SELGEM categories (see glossary) of data can be created simply by adding a unique 3 digit number to the file; data can be entered by paper tape (any code structure), port-a-punch cards, punched cards, or typed copy (Optical Character Recognition [OCR], see glossary); characters within a line, and lines within a SELGEM category can be added, modified, or deleted at any time; records can be added or deleted at any time; repetitious additions, modifications, and deletions need be entered only once; file cards, labels, reports (in formats specified by the user), and summarized reports with or without totals can be printed; indices can be made by word or phrase; and data files can be interfaced with map programs, photo-composition equipment, and statistical programs (see overview of SELGEM capabilities by D. Bridge, unpublished manuscript available through the NMNH ADP Program[1]).

This paper describes the NMNH Central American Ground Beetle (Carabidae *s. l.*) Faunal Study (hereafter referred to as "the Study"), which uses the SELGEM system. The Study (whose primary outcome will be a series of faunal manuals and subsequent analyses) has successfully applied SELGEM to various research requirements. After 3½ years of refining the Study, compatability has been achieved in all aspects from field note to data entry; this paper describes the capturing of data *from* field notes designed especially for the Study's output requirements *to* the entering of data for computer processing. It is hoped that future studies can benefit from the Study's present level of refinement. If data bases are built using the same computer system, definitions, and formats, more opportunities for uniform exchange of data about world faunas will exist.

The scientific work for this study is being done by Terry L. Erwin, Smithsonian Institution. The design of the work flow from field note to formats for encoding data, and the actual building of the data base, are handled by me. The Smithsonian's NMNH ADP Program and Office of Computer Services[1] do the computer processing and serve as SELGEM consultants.

In 1972 the Study shifted from conventional procedures of handling data (recording notes and literature citations on 5 by 7 inch cards, recording with pen or pencil lengthy field notes, and manually sorting and resorting specimens and cards for various needs) to using the computer as an aid in storage and retrieval of the massive quantity of data. The original plan was simply to build 2 computer files, one of specimen data and one of literature data, merge them, and then use the data in various combinations to aid in the faunal Study. The original plan remains, but the impact of the computer approach on the entire Study has been far greater than originally expected.

Particularly influenced is the structure and content of field notes, since

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in this early phase of research key data are first gathered and recorded. Formerly, field notes were written in an unstructured, unformatted, narrative style. Locality data, elevation, and general microhabitat were always entered into the notes; but ecological data such as community, macrohabitat, time of activity, etc., were randomly included, word synonymies were abundant, words and phrases lacked consistency in structure and definition (e.g. rot, rotting, rotten, decayed, decaying), and data were written in narrative paragraphs. These notes were not adaptable to the computer, since it works only with precise and consistent data. Also, retrievability of pertinent data from these notes was often dependent upon experience and memory recall, and many good field observations simply were forgotten for a lack of logical accumulation and organization. To use the computer, it was necessary to refine, format, and standardize field notes in order to maximize the efficiency, accuracy, and reliability of the data file.

Field notes are written on a printed form (Fig. 1), using a pocket-sized tape recorder for recording all required data on site. The 5½ by 8½ inch printed forms are kept in a 6½ by 9 inch loose leaf binder. A consecutive numbering system is used, providing each field note with a separate number for each specific microhabitat. One collecting vial is used for each microhabitat. In the evening, the specimens are transferred into storage vials of hardwood sawdust (Lindroth 1957) and field notes are transcribed for each microhabitat from the tape. Field identifications are rechecked and listed at the bottom and backside of each field note.

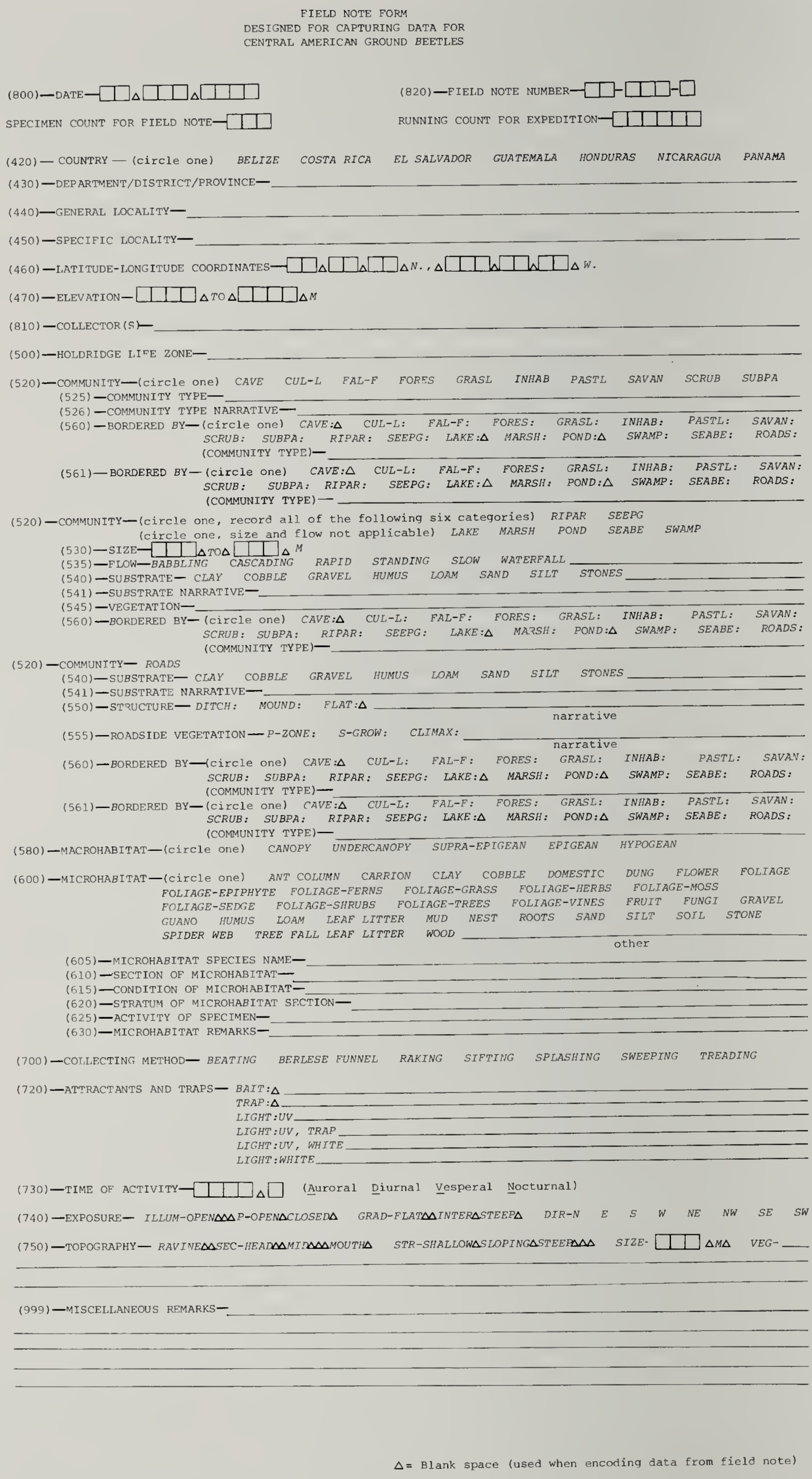
The printed form was designed to maximize efficiency and accuracy in recording notes. Specific locations are provided on the form for each kind of data item (see glossary) to be recorded. Where choices of items are few, key words are printed; the desired word(s) are encircled rather than written. The printed form enhances accuracy and eliminates the possibility of subsequent interpretation error, since the predetermined locations of data and the printed key words provide reminders of which data are to be recorded.

One or several forms might be filled out at each locality, depending upon the number of microhabitats investigated. On the first form such general information about the locality as country, province, etc. is recorded. Each subsequent form includes data on a microhabitat, and on the bottom and backside of the page a list of the taxa and number collected from the microhabitat. Typing data for computer entry is greatly facilitated by having a separate form for each microhabitat; this results in detailed field notes which contain most, if not all, of the data elements (see glossary) needed for later analysis.

Since the data elements which follow were specifically chosen and defined for the Central American Ground Beetle Faunal Study, there are not many gaps in data items computerized for specimens collected specifically for the Study; but there are many such gaps in the records of borrowed specimens. It has been possible in certain cases to locate the collector's field notes and find data not on the specimen labels. Also, certain data can be researched, such as latitude-longitude, province, or Holdridge Life Zone.

Appropriateness of the format and definitions of many of the data elements, especially those dealing with ecology, are still being tested. As the Study develops, many of these data elements will be expanded, dropped, or refined.

Codes and abbreviations have been used sparingly; only mnemonic



FIELD NOTE FORM
DESIGNED FOR CAPTURING DATA FOR
CENTRAL AMERICAN GROUND BEETLES

(800)—DATE—☐☐△☐☐☐△☐☐☐☐ (820)—FIELD NOTE NUMBER—☐☐-☐☐☐-☐

SPECIMEN COUNT FOR FIELD NOTE—☐☐☐ RUNNING COUNT FOR EXPEDITION—☐☐☐☐☐☐

(420)— COUNTRY — (circle one) *BELIZE COSTA RICA EL SALVADOR GUATEMALA HONDURAS NICARAGUA PANAMA*

(430)—DEPARTMENT/DISTRICT/PROVINCE—

(440)—GENERAL LOCALITY—

(450)—SPECIFIC LOCALITY—

(460)—LATITUDE-LONGITUDE COORDINATES—☐☐△☐☐△☐☐△*N.*,△☐☐☐△☐☐△☐☐△*W.*

(470)—ELEVATION—☐☐☐☐△*TO*△☐☐☐☐△*M*

(810)—COLLECTOR(S)—

(500)—HOLDRIDGE LIFE ZONE—

(520)—COMMUNITY—(circle one) *CAVE CUL-L FAL-F FORES GRASL INHAB PASTL SAVAN SCRUB SUBPA*
(525)—COMMUNITY TYPE—
(526)—COMMUNITY TYPE NARRATIVE—
(560)—BORDERED *BY*—(circle one) *CAVE:△ CUL-L: FAL-F: FORES: GRASL: INHAB: PASTL: SAVAN: SCRUB: SUBPA: RIPAR: SEEPG: LAKE:△ MARSH: POND:△ SWAMP: SEABE: ROADS:*
(COMMUNITY TYPE)—

(561)—BORDERED *BY*—(circle one) *CAVE:△ CUL-L: FAL-F: FORES: GRASL: INHAB: PASTL: SAVAN: SCRUB: SUBPA: RIPAR: SEEPG: LAKE:△ MARSH: POND:△ SWAMP: SEABE: ROADS:*
(COMMUNITY TYPE)—

(520)—COMMUNITY—(circle one, record all of the following six categories) *RIPAR SEEPG*
(circle one, size and flow not applicable) *LAKE MARSH POND SEABE SWAMP*
(530)—SIZE—☐☐☐△*TO*△☐☐☐△ *M*
(535)—FLOW—*BABBLING CASCADING RAPID STANDING SLOW WATERFALL*
(540)—SUBSTRATE— *CLAY COBBLE GRAVEL HUMUS LOAM SAND SILT STONES*
(541)—SUBSTRATE NARRATIVE—
(545)—VEGETATION—
(560)—*BORDERED* BY—(circle one) *CAVE:△ CUL-L: FAL-F: FORES: GRASL: INHAB: PASTL: SAVAN: SCRUB: SUBPA: RIPAR: SEEPG: LAKE:△ MARSH: POND:△ SWAMP: SEABE: ROADS:*
(COMMUNITY TYPE)—

(520)—COMMUNITY— *ROADS*
(540)—SUBSTRATE— *CLAY COBBLE GRAVEL HUMUS LOAM SAND SILT STONES*
(541)—SUBSTRATE NARRATIVE—
(550)—STRUCTURE— *DITCH: MOUND: FLAT:△*
narrative

(555)—ROADSIDE VEGETATION—*P-ZONE: S-GROW: CLIMAX:*
narrative

(560)—*BORDERED* BY—(circle one) *CAVE:△ CUL-L: FAL-F: FORES: GRASL: INHAB: PASTL: SAVAN: SCRUB: SUBPA: RIPAR: SEEPG: LAKE:△ MARSH: POND:△ SWAMP: SEABE: ROADS:*
(COMMUNITY TYPE)—
(561)—*BORDERED* BY—(circle one) *CAVE:△ CUL-L: FAL-F: FORES: GRASL: INHAB: PASTL: SAVAN: SCRUB: SUBPA: RIPAR: SEEPG: LAKE:△ MARSH: POND:△ SWAMP: SEABE: ROADS:*
(COMMUNITY TYPE)—

(580)—MACROHABITAT—(circle one) *CANOPY UNDERCANOPY SUPRA-EPIGEAN EPIGEAN HYPOGEAN*

(600)—MICROHABITAT—(circle one) *ANT COLUMN CARRION CLAY COBBLE DOMESTIC DUNG FLOWER FOLIAGE FOLIAGE-EPIPHYTE FOLIAGE-FERNS FOLIAGE-GRASS FOLIAGE-HERBS FOLIAGE-MOSS FOLIAGE-SEDGE FOLIAGE-SHRUBS FOLIAGE-TREES FOLIAGE-VINES FRUIT FUNGI GRAVEL GUANO HUMUS LOAM LEAF LITTER MUD NEST ROOTS SAND SILT SOIL STONE SPIDER WEB TREE FALL LEAF LITTER WOOD*
other

(605)—MICROHABITAT SPECIES NAME—
(610)—SECTION OF MICROHABITAT—
(615)—CONDITION OF MICROHABITAT—
(620)—STRATUM OF MICROHABITAT SECTION—
(625)—ACTIVITY OF SPECIMEN—
(630)—MICROHABITAT REMARKS—

(700)—COLLECTING METHOD— *BEATING BERLESE FUNNEL RAKING SIFTING SPLASHING SWEEPING TREADING*

(720)—ATTRACTANTS AND TRAPS— *BAIT:△*
TRAP:△
LIGHT:UV
LIGHT:UV, TRAP
LIGHT:UV, WHITE
LIGHT:WHITE

(730)—TIME OF ACTIVITY—☐☐☐☐△☐ (Auroral Diurnal Vesperal Nocturnal)

(740)—EXPOSURE— *ILLUM-OPEN△△△P-OPEN△CLOSED△ GRAD-FLAT△△INTER△STEEP△ DIR-N E S W NE NW SE SW*

(750)—TOPOGRAPHY— *RAVINE△△SEC-HEAD△△MID△△△MOUTH△ STR-SHALLOW△SLOPING△STEEP△△△ SIZE-* ☐☐☐ △*M*△ *VEG-*

(999)—MISCELLANEOUS REMARKS—

△= Blank space (used when encoding data from field note)

FIG. 1, Central American Field Note Form.

codes were used. First consideration is given to ease in usage and understandability; secondary consideration is given to savings in time. Since the Honeywell computer which the Smithsonian uses prints only upper case letters, the abbreviations are listed in upper case letters; periods are not used after abbreviations. Some abbreviations used in the Study are C = Centigrade; DET = Determined; E = East; F = Fahrenheit; HRS = Hours; HWY = Highway; JCT = Junction; KM = Kilometer(s); M = Meter(s); MI = Mile(s); MM = Millimeter(s); N = North; NR = Near; S = South; SP = Species; and W = West.

The cost of *computer processing* for entering specimen data and *making various queries and listings* using Procedure I[3] averaged $ 0.22 per specimen (average of 15 data lines per specimen) for 9,628 specimens. This figure includes experimentation costs, but it does not include such primary personnel costs as salary for personnel entering specimen data and arranging specimens for data entry. The cost of *computer processing* for entering specimen data *without queries and listings* using Procedures II and III[3] averaged $ 0.07 per specimen (average of 24 data lines per specimen) for 8,261 specimens. This figure does not include primary personnel costs. During the Study, the computer model used to process data was changed, computer programs changed constantly, charges for computer processing continually increased, and combinations of computer programs to process data varied. Therefore, these cost estimates are included only to give some idea of expenses necessary to undertake computerization of natural history data.

DATA CATEGORIES AND SELGEM CATEGORY NUMBERS USED IN THE CENTRAL AMERICAN CARABID NATURAL HISTORY STUDY[4] [5]

SPECIMEN NUMBER	010
DEPOSITORY	020
COLLECTION TRANSFER	030
SPECIMEN LOAN-RETURN	040
TRIBE	120
SUBTRIBE	130
GENUS	140
SUBGENUS	150
SPECIES	160
SUBSPECIES	170
IDENTIFIER BY TYPE COMPARISON	180
IDENTIFIER BY KEYS OR UNKNOWN METHOD OF COMPARISON	190
KIND OF TYPE	210
TYPE NUMBER	220
TYPE DESIGNATOR AND DATE	230
ORIGINAL TYPE NAME	240
STAGE OF METAMORPHOSIS	300
SPECIMEN MATURITY	310
SEX	320
SPECIMEN LENGTH	330
SPECIMEN WIDTH	340
WING LENGTH	350

ZOOGEOGRAPHIC REGION	400
COUNTRY	420
DEPARTMENT/DISTRICT/PROVINCE	430
GENERAL LOCALITY	440
SPECIFIC LOCALITY	450
LATITUDE-LONGITUDE	460
ELEVATION	470
HOLDRIDGE LIFE ZONE	500
COMMUNITY	520
COMMUNITY TYPE	525
COMMUNITY TYPE NARRATIVE	526
SIZE	530
FLOW	535
SUBSTRATE	540
SUBSTRATE NARRATIVE	541
VEGETATION	545
STRUCTURE	550
ROADSIDE VEGETATION	555
BORDERED BY	560
BORDERED BY	561
BORDERED BY	562
MACROHABITAT	580
MICROHABITAT	600
MICROHABITAT SPECIES NAME	605
SECTION OF MICROHABITAT	610
CONDITION OF MICROHABITAT	615
STRATUM OF MICROHABITAT SECTION	620
ACTIVITY OF SPECIMEN	625
MICROHABITAT REMARKS	630
COLLECTING METHOD	700
ATTRACTANTS AND TRAPS	720
TIME OF ACTIVITY	730
EXPOSURE	740
TOPOGRAPHY	750
DATE CAPTURED	800
COLLECTOR(S)	810
FIELD BOOK-NOTE NUMBERS AND HABITAT PHOTOGRAPH	820
COLLECTOR'S NUMBER	840
EXPEDITION	850
MISCELLANEOUS REMARKS	999

How Data Are Prepared for Computer Processing

For this Study, source data (specimen, specimen labels, and field note data) are entered into paper tape or into Hollerith 80 column IBM punch cards. Most source data are entered via paper tape typewriters, but for some categories, designed so that data begin and end in specific character positions, the Hollerith punch card is used. The Hollerith punch card is also used to enter corrections to the file. Methods of data capture other than paper tape and Hollerith punch cards are also available.

The paper tape typewriter is composed of a (program) reader, a punch, and a standard electric typewriter. Punched paper tape programs are read by the *program reader* which instructs the paper tape machine when to punch data, when to type data, when to stop for data entry, and so on. The *punch* punches selected data from the punched paper tape program and also punches the source data when they are typed.

When a reel of punched paper tape and/or a stack of punched cards (source data) are ready, Job Control Language (JCL) cards (also on punched cards) are made. The JCL cards instruct the computer to process the punched paper tape reel and/or punched cards with the appropriate SELGEM program, and also specify options which are available for each SELGEM program. After the JCL cards are made, the paper tape reel, Hollerith punched cards, and JCL cards are submitted to be processed.

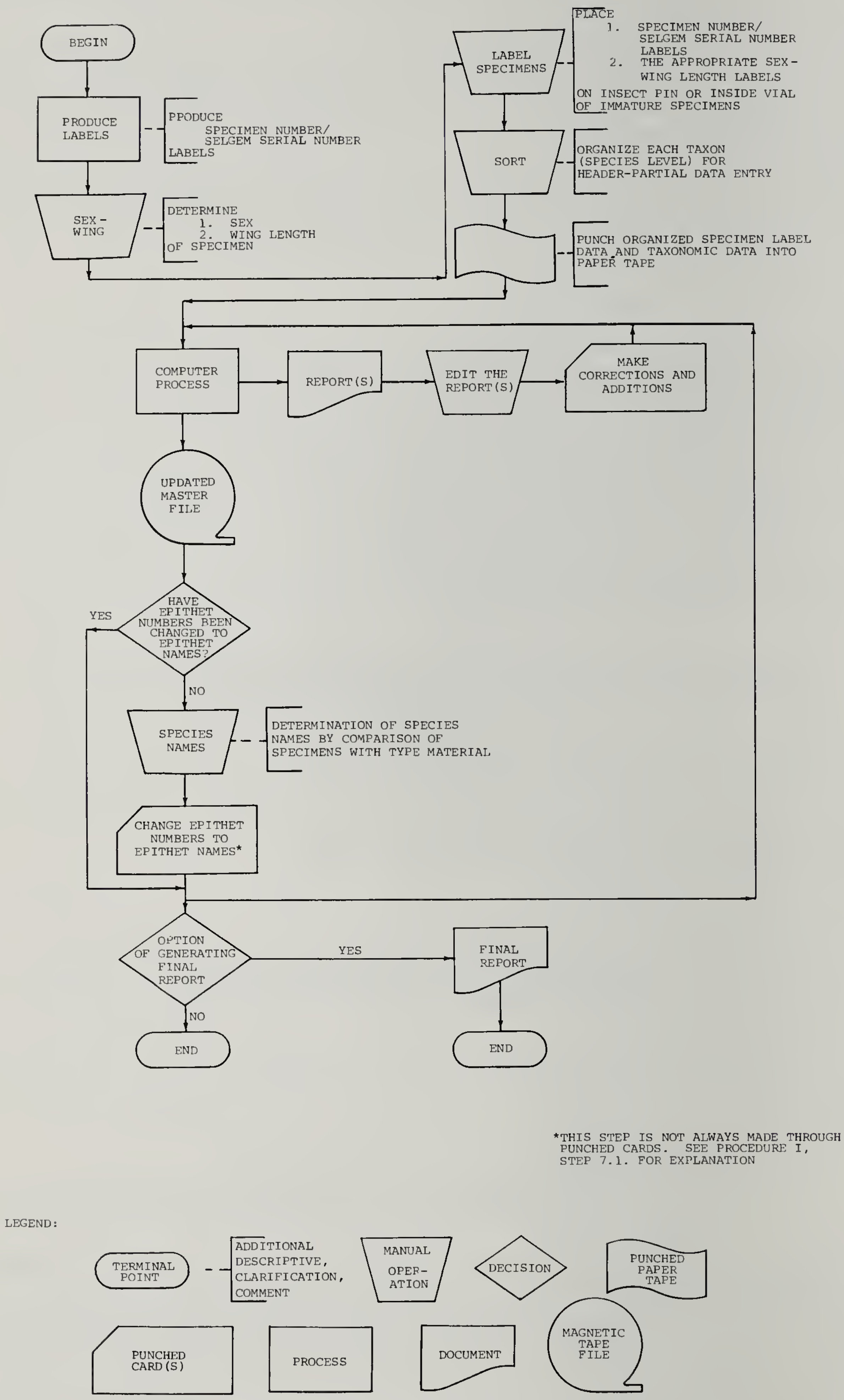
PROCEDURES FOR PREPARING AND GATHERING SOURCE DATA

Data are taken directly from the specimens and specimen labels and are punched immediately into paper tape. Three different procedures for preparing and gathering source data for computer processing are used in this Study. Which of the 3 procedures is used depends upon how the collection is arranged prior to data entry. Non-detailed flowcharts graphically illustrate the procedures used (Fig. 2, 6, and 7). A legend at the bottom of Fig. 2 defines the symbols used in the flowcharts. The explanations for the following 3 procedures are intended to explain the general work flow, not to describe the procedures in minute detail.

PROCEDURE I (FIG. 2): THE USNM COLLECTION WHICH WAS IDENTIFIED AND ORGANIZED TO SPECIES PRIOR TO DATA ENTRY

1.0 Produce a bulk quantity of specimen number/SELGEM serial number labels (see Fig. 3 for examples of labels; see category 010 for explanation of number; see Footnote 6 for method to produce the specimen number/SELGEM serial number label).
2.0 Determine sex of specimen (category 320) and wing length of specimen (category 350).
3.0 Place specimen number/SELGEM serial number label and the appropriate sex-wing length label (Fig. 5) on insect pin or place specimen number/SELGEM serial number label inside alcohol vial of immature specimens.
4.0 Sort each taxon (species level[7]) so that constant data items from specimen labels are together, enabling use of header-partial data entry (see Glossary). Examples:
    4.1.1 Put all Costa Rican specimens together.
    4.1.2 Put all Costa Rican, Limon Province, males, winged specimens together.
5.0 Punch header-partial organized specimen label data and taxonomic data into paper tape.
6.0 Computer process data. Outputs of the processed data generally are:
  6.1 A new master file or an updated master file on magnetic tape.
  6.2 Working reports.
    6.2.1 The reports are edited.
    6.2.2 Corrections and additions are prepared (generally on punched cards) to update the master file (see glossary).
    6.2.3 The corrections are computer processed.

FLOWCHART OF PROCEDURE I:
THE USNM COLLECTION WHICH WAS
IDENTIFIED AND ORGANIZED TO SPECIES PRIOR TO DATA ENTRY


BEGIN
PRODUCE LABELS
PRODUCE SPECIMEN NUMBER/ SELGEM SERIAL NUMBER LABELS
SEX - WING
DETERMINE 1. SEX 2. WING LENGTH OF SPECIMEN
LABEL SPECIMENS
PLACE 1. SPECIMEN NUMBER/ SELGEM SERIAL NUMBER LABELS 2. THE APPROPRIATE SEX-WING LENGTH LABELS ON INSECT PIN OR INSIDE VIAL OF IMMATURE SPECIMENS
SORT
ORGANIZE EACH TAXON (SPECIES LEVEL) FOR HEADER-PARTIAL DATA ENTRY
PUNCH ORGANIZED SPECIMEN LABEL DATA AND TAXONOMIC DATA INTO PAPER TAPE
COMPUTER PROCESS
REPORT(S)
EDIT THE REPORT(S)
MAKE CORRECTIONS AND ADDITIONS
UPDATED MASTER FILE
HAVE EPITHET NUMBERS BEEN CHANGED TO EPITHET NAMES?
YES
NO
SPECIES NAMES
DETERMINATION OF SPECIES NAMES BY COMPARISON OF SPECIMENS WITH TYPE MATERIAL
CHANGE EPITHET NUMBERS TO EPITHET NAMES*
OPTION OF GENERATING FINAL REPORT
YES
FINAL REPORT
NO
END
END
LEGEND:
TERMINAL POINT
ADDITIONAL DESCRIPTIVE, CLARIFICATION, COMMENT
MANUAL OPER-ATION
DECISION
PUNCHED PAPER TAPE
PUNCHED CARD(S)
PROCESS
DOCUMENT
MAGNETIC TAPE FILE

*THIS STEP IS NOT ALWAYS MADE THROUGH PUNCHED CARDS. SEE PROCEDURE I, STEP 7.1. FOR EXPLANATION

FIG. 2, Flowchart of Procedure I.

6.2.4 Steps 6.2.1 through 6.2.3 are repeated until all corrections and additions are satisfactorily completed.

7.0 Determination of species names by comparison of specimens with type material.

7.1 The epithet numbers are changed to epithet names either via punch cards or through various SELGEM programs. If the changes are made via punch cards, then steps 6.2.1 through 6.2.4 are repeated.

8.0 At this point the master file is basically finished. Working reports and/or final reports can be produced at any time. If latitude-longitude coordinates are included in the file, maps can be computer generated.

This was the first procedure used and also the slowest; as a result of using this procedure on 9,628 specimens, the other 2 methods were designed. If a collection is taxonomically arranged, the time spent to manually resort the specimens by locality for data entry ease, then resort the specimens back to the taxonomically arranged collection, in my experience, is not justified.

ADP 37238	ADP 37239	ADP 37240	ADP 37241	ADP 37242
ADP 37260	ADP 37261	ADP 37262	ADP 37263	ADP 37264
ADP 37282	ADP 37283	ADP 37284	ADP 37285	ADP 37286

ADP ADP ADP ADP ADP
37238 37239 37240 37241 37242
ADP ADP ADP ADP ADP
37260 37261 37262 37263 37264
ADP ADP ADP ADP ADP
37282 37283 37284 37285 37286

FIG. 3

ADP-USNM 19080820	ADP-CAS 19101101	ADP-MCZ 19410908	ADP-AMNH 19751224

FIG. 4

♀ winged	♀ short-winged	♀ wingless
♂ winged	♂ short-winged	♂ wingless

FIG. 5

FIG. 3-5, Labels: 3) ADP specimen number labels used presently by the Study; 4) Proposed specimen ADP number labels; 5) Sex/Wing specimen labels.

PROCEDURE II (FIG. 6): UNSORTED COLLECTIONS WHICH HAVE BEEN BORROWED FROM PUBLIC (MUSEUM) AND/OR PRIVATE SOURCES

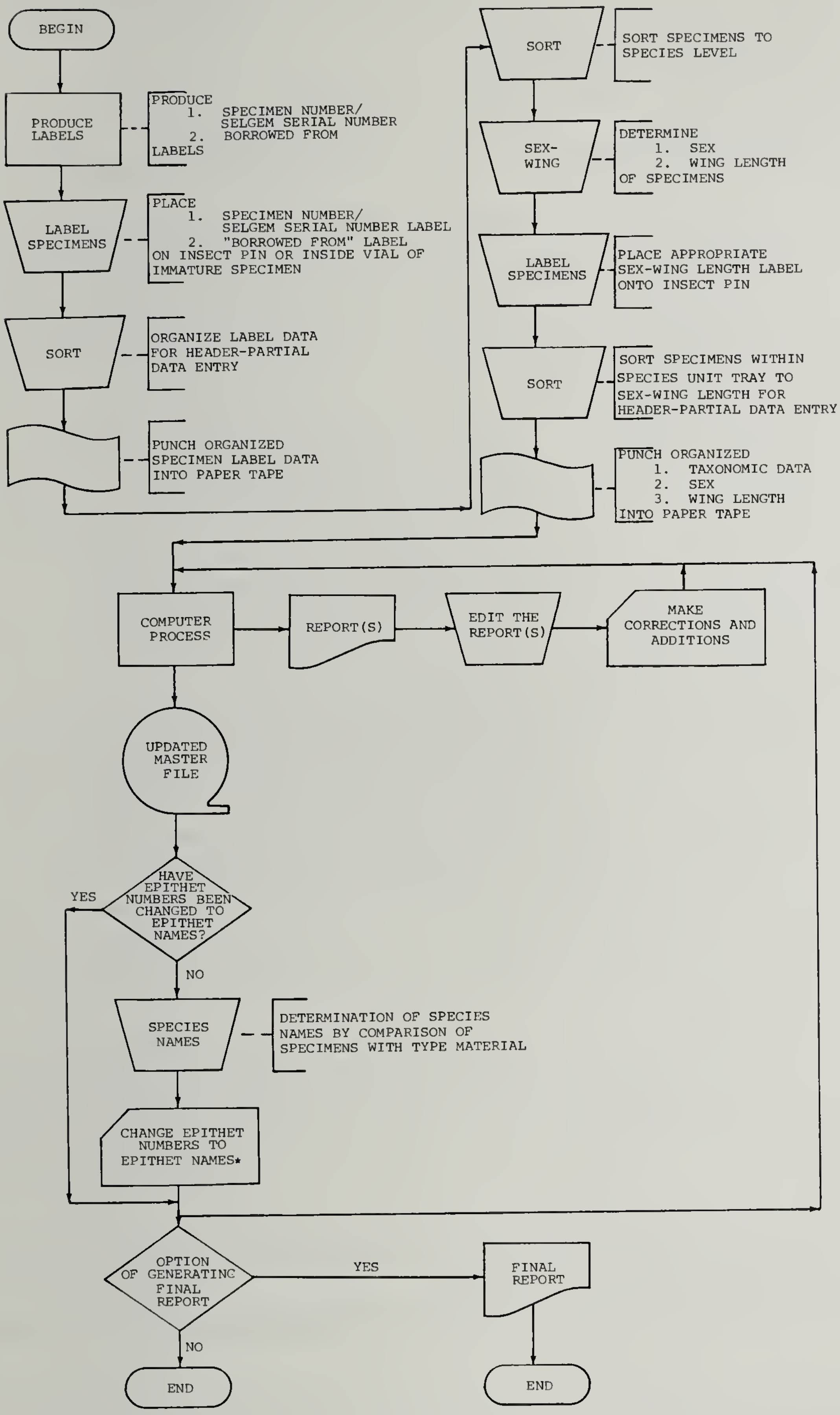
1.0 Produce labels
  1.1 Produce a bulk quantity of specimen number/SELGEM serial number labels (category 010) (step 1.0 in Procedure I).
  1.2 Produce "borrowed from" labels, if the specimens do not have adequate depository identification (category 020).
2.0 Label specimens
  2.1 Place specimen number/SELGEM serial number labels (category 010) on insect pins or inside alcohol vials of immature specimens.
  2.2 Place "borrowed from" labels on the insect pins which do not have adequate depository identification.
3.0 Sort specimens by label data so that constant data items are together, enabling header-partial data entry (steps 4.1.1, 4.1.2 in Procedure I). When punching the data into the paper tape, it is useful to slant the specimens in the unit tray (see glossary) as they are being sorted, so that the label data is seen at a glance.
4.0 Punch header-partial organized specimen label data into paper tape (categories such as 010, 020, 030, 210, 220, 230, etc.).
5.0 Sort specimens to species level.
  5.1 Label each unit tray with the appropriate Genus name and epithet number.[7]
6.0 Determine sex and wing length of specimen.
7.0 Place appropriate sex-wing length labels on insect pin (see Fig. 5).
8.0 Sort specimens within each species unit tray to sex-wing length for header-partial data entry.
9.0 Punch taxonomic names and numbers (categories 120, 130, 140, 150, 160), sex (category 320) and wing length (category 350) into paper tape.
10.0 Computer process data (steps 6.0 through 6.2.4 in Procedure I).
11.0 Determination of species names by comparison of specimens with type material (step 7.1 in Procedure I).
12.0 At this point the master file is basically finished (step 8.0 in Procedure I).

The result of Procedure II is rapid entry of specimen data by less repetitious typing of the same header data. By splitting and sorting the collection twice, typing of the locality header data and the taxonomic data is reduced to merely one entry and the chance of typing errors is minimized. With Procedure I, manual sorting takes place within each unit tray for header-partial data entry, and both sorting and typing are done on a small scale. With Procedure II, massive sorting takes place in one operation and less typing is needed, resulting in relatively fast entry of data.

PROCEDURE III (FIG. 7): NEW MATERIAL (SPECIMEN, SPECIMEN LABEL, AND FIELD NOTE DATA) FROM THE STUDY'S CENTRAL AMERICAN EXPEDITIONS

1.0 Produce labels.
  1.1 Produce a bulk quantity of specimen number/SELGEM serial number labels (category 010) (step 1.0 in Procedure I).
  1.2 Produce specimen labels for the expedition.

FLOWCHART OF PROCEDURE II:
UNSORTED COLLECTIONS WHICH HAVE BEEN BORROWED FROM
PUBLIC (MUSEUMS) AND/OR PRIVATE SOURCES


BEGIN
PRODUCE LABELS
PRODUCE 1. SPECIMEN NUMBER/ SELGEM SERIAL NUMBER 2. BORROWED FROM LABELS
LABEL SPECIMENS
PLACE 1. SPECIMEN NUMBER/ SELGEM SERIAL NUMBER LABEL 2. "BORROWED FROM" LABEL ON INSECT PIN OR INSIDE VIAL OF IMMATURE SPECIMEN
SORT
ORGANIZE LABEL DATA FOR HEADER-PARTIAL DATA ENTRY
PUNCH ORGANIZED SPECIMEN LABEL DATA INTO PAPER TAPE
SORT
SORT SPECIMENS TO SPECIES LEVEL
SEX-WING
DETERMINE 1. SEX 2. WING LENGTH OF SPECIMENS
LABEL SPECIMENS
PLACE APPROPRIATE SEX-WING LENGTH LABEL ONTO INSECT PIN
SORT
SORT SPECIMENS WITHIN SPECIES UNIT TRAY TO SEX-WING LENGTH FOR HEADER-PARTIAL DATA ENTRY
PUNCH ORGANIZED 1. TAXONOMIC DATA 2. SEX 3. WING LENGTH INTO PAPER TAPE
COMPUTER PROCESS
REPORT(S)
EDIT THE REPORT(S)
MAKE CORRECTIONS AND ADDITIONS
UPDATED MASTER FILE
HAVE EPITHET NUMBERS BEEN CHANGED TO EPITHET NAMES?
YES
NO
SPECIES NAMES
DETERMINATION OF SPECIES NAMES BY COMPARISON OF SPECIMENS WITH TYPE MATERIAL
CHANGE EPITHET NUMBERS TO EPITHET NAMES*
OPTION OF GENERATING FINAL REPORT
YES
FINAL REPORT
NO
END
END

*THIS STEP IS NOT ALWAYS MADE THROUGH PUNCHED CARDS. SEE PROCEDURE I, STEP 7.1. FOR EXPLANATION.

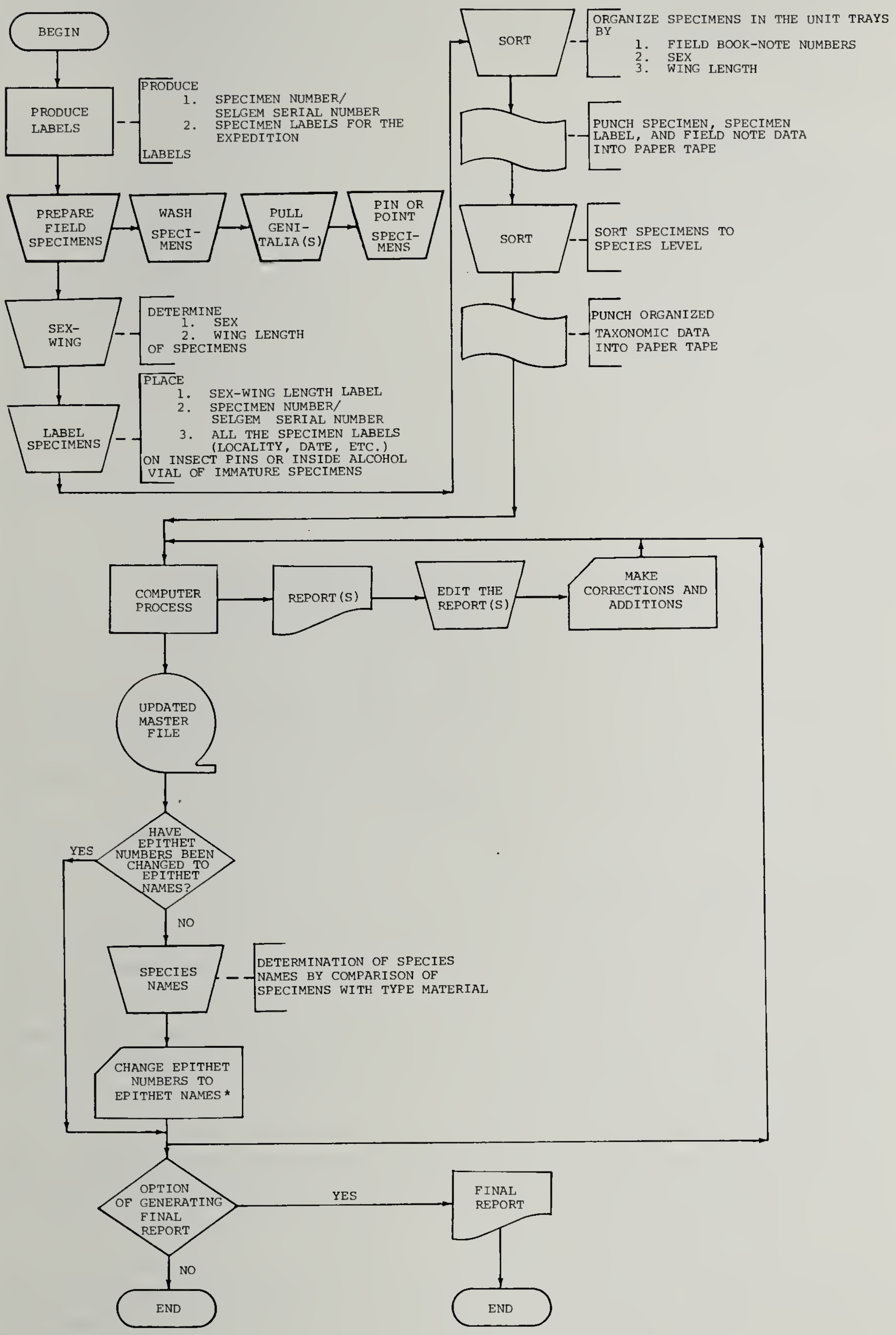
FIG. 6, Flowchart of Procedure II.

2.0 Prepare field specimens.
  2.1 Wash specimens in warm detergent water in a sonic cleaner; rinse specimens in warm or cool clear water under a faucet.
  2.2 When pinning or pointing specimens, pull the genitalia while the specimen is relaxed. Specimens are killed with ethyl acetate (see Lindroth, 1957, 1969).
3.0 Determine sex and wing length of specimens.
4.0 Label specimens.
  4.1 Place appropriate sex-wing length labels on insect pin (see Fig. 5).
  4.2 Place specimen number/SELGEM serial number (category 010) on insect pin or inside alcohol vial of immature specimens. (See Fig. 8 for the arrangement of the 2 labels on the pin. Note that at a glance you can see the sex, wing length, and specimen number. Data entry is faster if these 2 labels are placed at the top of the stack of labels.)
  4.3 Place all specimen labels on the insect pins or inside alcohol vials of immature specimens (i.e. locality with latitude-longitude, date, ecological label data, etc.).
5.0 Sort the specimens in the unit trays by field book-note numbers (category 820), sex (category 320) and wing length (category 350).
6.0 Punch label data and field note data into paper tape (i.e. locality, date, ecological label data, etc.).
By having the specimens organized by field book-note numbers, sex, and wing length, all the label data will automatically be grouped for rapid header-partial data entry. The header record will be typed only once and will be followed by the partial records which will have the specimen number/SELGEM serial number and all the data for the specific individual specimen (i.e. ecological data, possibly specimen maturity [category 310] if the specimen is teneral).
7.0 Sort specimens to species level.
  7.1 Label each unit tray with the appropriate Genus name and epithet number.[7]
8.0 Punch taxonomic data (categories 120, 130, 140, 150, 160) into paper tape. By having the specimens organized taxonomically only one header record typing for each taxon is needed, followed simply by partial records containing the specimen number/SELGEM serial number.
9.0 Computer process data (steps 6.0 through 6.2.4 in Procedure I).
10.0 Determination of species names by comparison of specimens with type material (steps 7.1 in Procedure I).
11.0 At this point the master file is basically finished (step 8.0 in Procedure I).

In contrast to Procedures I and II where the latitude-longitude coordinates may not be (originally) in the file, Procedure III will already have had the coordinates incorporated into the file and therefore computer generated maps can be produced at any time.

This procedure is the most efficient of the 3 methods described, since the entire procedure from recording field notes to querying the file has been designed specifically for the Study with maximum efficiency and minimum usage of time.

FLOWCHART OF PROCEDURE III:
NEW MATERIAL (SPECIMEN, SPECIMEN LABEL, AND FIELD NOTE DATA)
FROM THE STUDY'S CENTRAL AMERICAN EXPEDITIONS


BEGIN
PRODUCE LABELS
PRODUCE 1. SPECIMEN NUMBER/ SELGEM SERIAL NUMBER 2. SPECIMEN LABELS FOR THE EXPEDITION LABELS
PREPARE FIELD SPECIMENS
WASH SPECI-MENS
PULL GENI-TALIA (S)
PIN OR POINT SPECI-MENS
SEX-WING
DETERMINE 1. SEX 2. WING LENGTH OF SPECIMENS
LABEL SPECIMENS
PLACE 1. SEX-WING LENGTH LABEL 2. SPECIMEN NUMBER/ SELGEM SERIAL NUMBER 3. ALL THE SPECIMEN LABELS (LOCALITY, DATE, ETC.) ON INSECT PINS OR INSIDE ALCOHOL VIAL OF IMMATURE SPECIMENS
SORT
ORGANIZE SPECIMENS IN THE UNIT TRAYS BY 1. FIELD BOOK-NOTE NUMBERS 2. SEX 3. WING LENGTH
PUNCH SPECIMEN, SPECIMEN LABEL, AND FIELD NOTE DATA INTO PAPER TAPE
SORT
SORT SPECIMENS TO SPECIES LEVEL
PUNCH ORGANIZED TAXONOMIC DATA INTO PAPER TAPE
COMPUTER PROCESS
REPORT (S)
EDIT THE REPORT (S)
MAKE CORRECTIONS AND ADDITIONS
UPDATED MASTER FILE
HAVE EPITHET NUMBERS BEEN CHANGED TO EPITHET NAMES?
YES
NO
SPECIES NAMES
DETERMINATION OF SPECIES NAMES BY COMPARISON OF SPECIMENS WITH TYPE MATERIAL
CHANGE EPITHET NUMBERS TO EPITHET NAMES*
OPTION OF GENERATING FINAL REPORT
YES
FINAL REPORT
NO
END
END

*THIS STEP IS NOT ALWAYS MADE THROUGH PUNCHED CARDS. SEE PROCEDURE I, STEP 7.1. FOR EXPLANATION

FIG. 7, Flowchart of Procedure III.

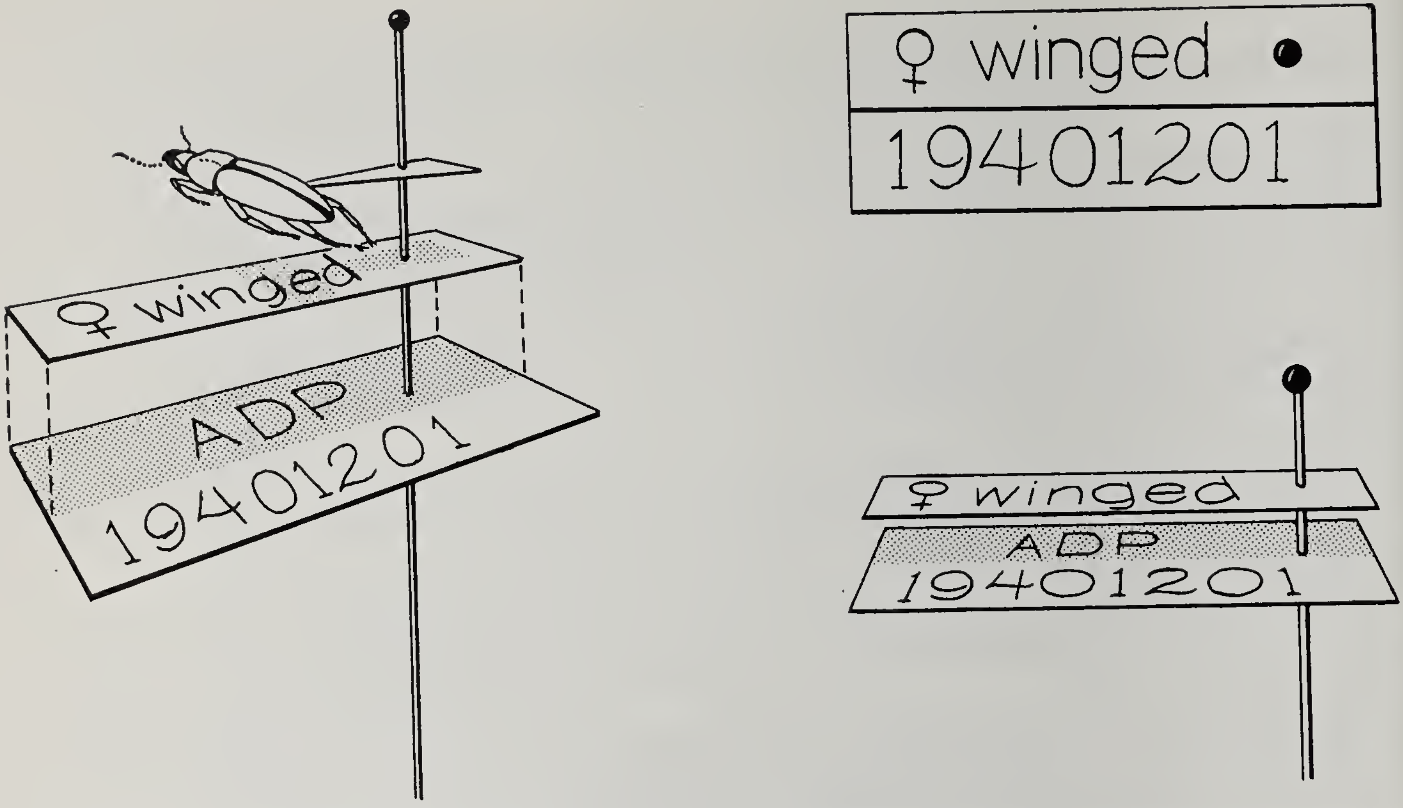


FIG. 8, Arrangement of Sex/Wing and ADP specimen number labels on insect pin.

DESCRIPTIONS OF CATEGORIES USED AND HOW THEY ARE FORMATTED AND ENCODED FOR FIELD NOTES AND FOR DATA PROCESSING[8]

For this Study most of the categories below are encoded into paper tape (except where noted) for subsequent transferral to magnetic tape. Other methods of data encodement are available, such as card punch machines and OCR (Optical Character Recognition).

Specimen Number (category 010)[9]

Every Central American Ground Beetle adult or immature specimen examined is randomly assigned a unique number not to exceed 8 digits. A label with this specimen number is attached to the insect pin for each adult or placed in the vial for each immature. Data can be traced back to each individual specimen, and/or data on any individual specimen can be retrieved, by using this unique number.

SELGEM identifies each stored record with an 8 character serial number. The *specimen number* and the *serial number* perform 2 completely separate functions; but for *this* Study the 2 numbers are designed to correspond to each other. Therefore, when reference is made to a specimen number, the specimen number will equal the serial number; but the serial number will *always* be an 8 digit (or character) number, e.g. 00001921, whereas the specimen number may be *smaller* than 8 digits, e.g. 1921. If the specimen number entry is less than 8 characters, a SELGEM program automatically generates leading zeros for the serial number. The specimen number labels are generated sequentially in intervals of one (e.g. 1, 2, 3, 4, etc.). To avoid confusion as to the meaning of the specimen label number, the acronym "ADP" was included on each specimen number label, as in Fig. 3. An improvement would be to add the name (acronym) of the depository, as in Fig. 4.

For other studies, lot numbers rather than individual specimen numbers may be used (such as all Ciidae captured in one bracket fungus, J. Lawrence, pers. comm.), if specimen uniqueness is not presently needed (e.g., sex or measurements of individual specimens). Subsequently, if individual specimen data are required, the lot number could be manipulated with computer techniques to produce individual specimen numbers.

Depository (category 020)

The acronym of the specimen depository is entered in this category. For the Study a 4 character acronym is assigned for a museum, unless a museum has an established acronym such as CAS, CNC, CSIRO, or MCZ. If specimens are borrowed from a private collection, a 6 character acronym is formed by combining the first 4 characters of the surname and the first letter of the first and middle names of the private collections' owner. If the surname has less than 4 characters, or if there is no middle initial, hyphens are used to replace the absent data characters (e.g. WHITDR; LEE-HH; KAVAD-).

Collection Transfer (category 030)

The historical continuum of the collections' depositories are entered in this category. Data in this category will allow future workers to easily reassemble population samples which have been separated for deposit in diverse museums. The format used is: *ORIGINAL DEPOSITORY, semicolon, blank space,*[10] and the *NEXT SEQUENTIAL DEPOSITORY* (e.g. DARLPJ;*MCZ;*USNM).

Specimen Loan-Return (category 040)

When a specimen in the Central American Study is loaned to an individual, the person's name, acronym of the museum with which the person is associated, date of loan, and date of return are entered in this category. The data for this category are entered into Hollerith 80 column IBM punch cards, not paper tape. Columns 1-15 are used for record identification. Data begin in column 16. The *NAME* of the individual to whom the loan is made is entered beginning in column 16. (See category 810 for the format used for entering person's names.) The *MUSEUM ACRONYM* to which the person is associated is entered in columns 50-53. The *DATE THE SPECIMEN WAS LOANED* is entered in columns 56-66. (See category 800 for the format used for entering dates.) The *DATE THE SPECIMEN IS RETURNED* is entered in columns 69-79. The format used from columns 50 to 80 is: UWIC**27*NOV*1973**02*DEC*1975*

Tribe (category 120)
Subtribe (category 130)
Genus (category 140)
Subgenus (category 150)
Species (category 160)
Subspecies (category 170)

The above 6 taxonomic levels are entered in separate categories. Individual levels can be easily queried, as well as combinations of the taxonomic levels. Except for Species (category 160), all taxa are entered normally, i.e. BEMBIDIINI, for category 120, BEMBIDIINA, for category 130, etc. When the specimens are sorted to species, each species is assigned an epithet number, rather than an epithet name. This epithet number is entered in category 160, and remains in the computer file until comparison with types is completed. After the type comparisons are made, changing the epithet numbers to names is easily accomplished with common data processing techniques.

Identifier by Type Comparison (category 180)

A person's name and year of identification is entered in this category when the person is known to have identified the specimen on the basis of: 1) having seen the type; 2) having designated the lectotype or neotype; 3) having published on the taxon after seeing most types in the genus; or 4) having established reliable homotype material for comparative purposes. The format used is: *NAME* of the 180 Identifier (following the format explained under Collectors(s), category 810), *blank space,* abbreviation *DET* (determined), *blank space, YEAR* the identification was made, if available (e.g. DARLINGTON,P.J.*DET*1974).

Identifier by Keys or Unknown Method of Comparison (category 190)

If a determiner's name is included on the specimen label and it is not known whether the identifier used the methods described under category 180, then the identifier's name, year of identification, and determination are entered in this category. The format used is: *NAME* of the 190 Identifier (following the format explained under Collectors(s), category 810), *blank space,* abbreviation *DET* (determined), *blank space, YEAR* the identification was made, if available, *blank space,* and the *DETERMINATION* made (e.g. NEVERMANN,F.*DET *1931* CICINDELA*ARGENTATA*FABRICIUS).

Kind of Type (category 210)

If the specimen is labeled as a type, the kind of type is entered in this category, i.e. HOLOTYPE, PARATYPE, ALLOTYPE, SYNTYPE, HOMOTYPE, TOPOTYPE, NEOTYPE, LECTOTYPE, or PARALECTOTYPE.

Type Number (category 220)

Labels on type specimens frequently include the catalogue type number designated by the depository museum(s). This category includes the type number and is preceded by the depository's acronym. The format used is: *DEPOSITORY* where the type was catalogued, *blank space, TYPE NUMBER* (e.g. USNM*22101). If the specimen type labels indicate they have been catalogued differently in different depositories, then the depositories are listed sequentially, separated by a semicolon and a blank space (e.g. USNM*22101;*MCZ*94590).

Type Designator and Date (category 230)

The designator of the type followed by the year in which the determination was made, if available from the specimen label, is entered in this category. The format used is: *TYPE DESIGNATOR* (following the format explained under Collector(s) category 810), *blank space,* abbreviation *DET* (determined), *blank space, YEAR* the type was designated if available (e.g. LINDROTH,C.H.*DET*1974).

Original Type Name (category 240)

The name of the type (*exactly* as it appears on the specimen label) is entered in this category (e.g. AGRA DARLINGTONI STRANEO, A. DARLINGTONI, DARLINGTONI STRANEO, or simply DARLINGTONI).

Stage of Metamorphosis (category 300)

The stage of metamorphosis in which the specimen is preserved is entered in this category.[11] [12] Possible entries in this category are:

EGG
LARVAL*INSTAR,*FIRST
LARVAL*INSTAR,*SECOND
LARVAL*INSTAR,*THIRD
LARVAL*INSTAR,*FOURTH
LARVAL*INSTAR,*FIFTH
PUPA
ADULT

Specimen Maturity (category 310)

If the specimen is a fully hardened and pigmented adult, data are not entered. If the adult specimen is teneral, then one of the following 3 descriptive terms is entered in this category:

TENERAL-UNPIGMENTED
TENERAL-PARTIALLY*PIGMENTED
TENERAL-PIGMENTED

TENERAL-UNPIGMENTED is an extremely pale or nearly transparent and soft specimen preserved just after it emerged from the pupal stage; usually the abdomen is collapsed. TENERAL-PARTIALLY* PIGMENTED is a pale specimen which has not acquired its complete color; usually the abdomen is fully formed and not collapsed. TENERAL-PIGMENTED describes a specimen which has acquired full color, yet is still soft when collected.

Sex (category 320)

The sex of the specimen is entered in this category. Either FEMALE, MALE, two hyphens (--), or a question mark (?) is entered. The two hyphens are used if the sex is undeterminable prior to dissection. The question mark is used if the specimen is too badly damaged to determine the sex.

Specimen Length (category 330)

The "standardized body length" (Ball 1972) measured in millimeters (MM) is entered in this category. The format used is: a *3 DIGIT NUMBER* (using leading zeros if necessary), *decimal point, one DIGIT* to the right of the decimal, *blank space,* abbreviation *MM* (e.g. 011.0*MM).

Specimen Width (category 340)

The specimen width measured in millimeters (MM) across the widest part of the elytra is entered in this category. The format used is: a *3 DIGIT NUMBER* (using leading zeros if necessary), a *decimal point, one DIGIT* to the right of the decimal, *blank space,* abbreviation *MM* (e.g. 006.5*MM).

Wing Length (category 350)

One of 3 descriptive terms (WINGED, SHORT-WINGED, or WINGLESS) is entered in this category to indicate the degree of development in the membraneous pair of metathoracic wings. WINGED refers to fully developed wings which extend beyond the stigma. SHORT-WINGED refers to a range of truncation at the stigma to a small veined pad. WINGLESS refers to a degree of development which ranges from a veinless pad to an apterous form.

Zoogeographic Region (category 400)

The zoogeographic regions as defined by Wallace (1876) and used by Darlington (1957) are entered in this category. For the Central American Study all entries are NEOTROPICAL, but as the Study evolves to include faunas other than Central America, the Study will expand to include the 6 other regions included in Wallace's Zoogeographic division (i.e. NEARCTIC, PALEARCTIC, ETHIOPEAN, ORIENTAL, AUSTRALIAN, and OCEANIA). The Zoogeographic Region will be used as an indicator in detecting distribution patterns.

Zoogeographic Subregion (category 410)

Category 410 is being reserved for Zoogeographic Subregion which will be used when the Study expands to include zoogeographic regions other than Neotropical.

Country (category 420)[13]

The Central American country in which the specimen was collected is entered in this category (i.e. BELIZE, COSTA RICA, EL SALVADOR, GUATEMALA, HONDURAS, NICARAGUA, PANAMA).

Department/District/Province (category 430)[13] [14]

The major administrative division of the country is entered in this category. The generic name of the administrative division (DEPARTMENT, DISTRICT, or PROVINCE) follows the specific administrative division (e.g. BOCAS DEL TORO PROVINCE).

General Locality (category 440)

A designated vicinity (a city, town, village, or river) that is at or near the actual field site and is easily located on major maps is entered in this category (e.g. PANAMA CITY; RIO ESCARREA).

Specific Locality (category 450)

The details which provide the closest proximity available for the collecting site are entered in this category. Notation's such as the number of miles or kilometers from the "general locality," or the name of a trail with the number of miles or kilometers from a given point are included. Miles will ultimately be converted to kilometers. For purposes of consistency in retrieval sorting, numbers are converted to a 3 digit number (using leading zeros), with one place to the right of the decimal point. Numbers are listed first, followed by the descriptive details (e.g. 030.8 MI N OF; or 000.3 KM SW OF BIOLOGICAL STATION ON FLORA TRAIL BETWEEN POSTS 11 and 12).

Latitude-Longitude (category 460)

The latitude-longitude coordinates of the specific or general locality are entered in this category. The format used for this Study is:

Latitude	*Longitude*
00*00*00*N.,	*000*00*00*E.
00*00*00*S.,	*000*00*00*W.

If the coordinates are not available, hyphens are inserted in place of the numbers. Leading zeros are used to complete the two and/or three digit numbers (e.g. 09*10*--N.,*079*50*--W.).

Elevation (category 470)

Elevation in meters (M) is entered in this category. The format used is: a *4 DIGIT NUMBER* (using leading zeros if necessary), *blank space,* and the code *M* (e.g. 0200*M). The format used for an elevation range is: a *4 DIGIT NUMBER, blank space, TO, blank space, 4 DIGIT NUMBER, blank space,* and an *M* (e.g. 0300*TO*0450*M).

Holdridge Life Zone (category 500)

One Holdridge Life Zone name (Holdridge 1971) is entered in this category (e.g. TROPICAL DRY FOREST).

Community (category 520)

A broad expression describing the general surroundings of the microhabitat is entered in this category. Presently, the Study uses 18 community divisions, entered as either 4 or 5 character words: CAVE, CUL-L (cultivated land); FAL-F (fallow field); FORES (forest); GRASL (grassland); INHAB ("inhabitation"—in dwelling, parking lot, or similar disturbed area); LAKE; MARSH; PASTL (pastureland); POND; RIPAR[15] (riparian);

ROADS (roadside, used also as trail); SAVAN (savannah); SCRUB; SEABE (seabeach); SEEPG (seepage); SUBPA (subparamo); and SWAMP.

Community Type (category 525)

When a specific kind of community descriptor is available, it is entered in this category. (e.g. If CUL-L was entered in category 520, then CORN, COFFEE, LETTUCE, etc. would be entered. If FORES was entered in category 520, then OAK, PINE, FICUS, etc. would be entered in this category.)

Community Type Narrative (category 526)

Narrative remarks concerning category 526 are entered in this category (e.g. CROPS HARVESTED, STALKS OLD AND DRY).

Size (category 530)

If the community category (520) is RIPAR or SEEPG, the width of the primary flood plain estimated in meters is entered in this category. The format used is: a *3 DIGIT NUMBER* (using leading zeros if necessary), *blank space,* and an *M* (e.g. 020*M). The format used for a size range is: a *3 DIGIT NUMBER, blank space, TO, blank space,* and an *M* (e.g. 020*TO*030*M).

Flow (category 535)

If the community category (520) is RIPAR or SEEPG, a descriptive term for flow is entered in this category. These descriptors are intended to create an image for the users. The Study uses the following at present:

WATERFALL (steep gradient, water loses contact with substrate);
CASCADING (steep gradient, water flow is extremely rapid, but does not lose contact with substrate, all "white water");
RAPID (moderately steep, water moves swiftly, mix of "white water" and smooth surface, used only for large amounts of water);
BABBLING (as in "rapid," but used for small amounts of water, such as rills and brooks);
SLOW (low gradient, water obviously moves but has no "white water" on surface);
STANDING (no gradient, water is not obviously moving, usually restricted to ponds in intermittent stream or river bed);
DRY WATERCOURSE (any intermittent watercourse which is in its dry state).

Substrate (category 540)

If the community category (520) is LAKE, MARSH, POND, RIPAR, ROADS, SEABE, SEEPG, or SWAMP, a descriptive term for substrate is entered in this category. The terms used describing substrate are:

BOULDER (large rock requiring an implement such as a crowbar to turn over);
CLAY (firm, plastic, fine-grained earth, chiefly aluminum silicate);
COBBLE (fist-size rounded stones which can easily be turned over with one hand);

GRAVEL (loose mixture of pebbles and rock fragments, coarser than sand, often mixed with clay, etc.);
HUMUS (brown or black product of the partial decay of leaves and other vegetable matter);
LATERITE (red, porous deposit containing large amounts of aluminum and ferric hydroxides, formed by the decomposition of certain rocks);
LEAF MOLD (rich soil consisting largely of decayed leaves);
LEAF LITTER (surface layer of the forest floor or elsewhere in which the leaves are slightly decomposed);
LOAM (rich soil composed of clay, sand, and some organic matter);
PEBBLE (small stone worn smooth and round, as by the action of water, about an inch or less in diameter);
SAND (loose, gritty particles of worn or disintegrated rock);
SILT (any earthy material composed of fine particles, as soil or sand, suspended in or deposited by water);
STONE (rock of relatively small size requiring two hands to turn over).

If there are two or more substrate terms, then on the field note form the descriptors are encircled with a 1, 2, 3, etc. to show the order of dominance. When encoding data the descriptors are listed in order of dominance and separated by a semicolon and a blank space (e.g. LEAF LITTER;*LEAF MOLD).

Substrate Narrative (category 541)

If the substrate category (540) requires narrative remarks, they are entered in this category (e.g. A THIN LAYER OF HUMUS ON ROCK SLABS).

Vegetation (category 545)

If the community category (520) is SAVAN, SCRUB, or SUBPA, then the dominant plant species is (are) entered in this category (e.g. HYPERICUM CARACASANUM).

If the community category (520) is LAKE, MARSH, POND, RIPAR, ROADS, SEABE, SEEPG, or SWAMP, the dominant associated plant species is (are) entered in this category (e.g. CAREX SPP.).

If there are 2 or more plant species, they are listed in order of dominance and separated by a semi-colon and a blank space (e.g. TYPHA LATIFOLIA; *CAREX VULPINOIDEA).

Structure (category 550)

If the community category (520) is ROADS, one of 3 terms describing the roadside structure (DITCH, MOUND, or FLAT) and narrative comments (if needed) are entered in this category. If narrative comments follow one of the terms, the terms are entered so that the narrative remarks begin on the 7th data character position (see glossary); the terms are followed by a colon with either one or zero blank spaces following the colon, depending upon the number of characters in the term. The format possibilities are:

DITCH:narrative
MOUND:narrative
FLAT:*narrative

DITCH refers to drainage areas along roadways purposely dug for keeping the road bed dry; these ditches are usually maintained periodically for proper water drainage. MOUND refers to soil pushed up by the road graders and left along the road as a mound which is soon covered by pioneer vegetation. FLAT refers to that portion of the road bed which has been graded flat and left to pioneer plants.

Roadside Vegetation (category 555)

If the datum in the community category (520) is ROADS, one of 3 terms describing the zone for roadside vegetation (and narrative comments if needed) is (are) entered in this category. The 3 roadside vegetation zone terms are P-ZONE (pioneer zone), S-GROW (second growth), and CLIMAX (climax growth). If narrative comments follow one of the terms, the term is entered so that the narrative remarks begin on the 8th data character position; the terms are followed by a colon. The format possibilities are:

P-ZONE:narrative
S-GROW:narrative
CLIMAX:narrative

PIONEER ZONE refers to recently disturbed road margins with annual herbs and grasses and perhaps small shrubs and seedling trees; this zone is common on new and well maintained roadways. SECOND GROWTH refers to relatively undisturbed roadsides with small trees and shrubs and usually perennial herbs and grasses. CLIMAX GROWTH refers to mature stands of forest trees found normally only along old, poorly maintained roads or paths.

Bordered-by (category 560)

The community (and the community type if it applies) which *borders* the community (category 520) is (are) entered in this category. The bordered-by communities are entered as either a 4 or 5 character word (see category 520). If a community type (category 525) follows the bordered-by community, its entry begins in the 7th data character position. The format used is: *BORDERED-BY COMMUNITY* (first 4 or 5 characters), *colon, blank space (only* if the bordered-by community is a 4 character word), and the *COMMUNITY TYPE* (beginning in the 7th data character position). Examples of what may appear in category 560 if ROADS was entered in category 520 are: FORES:MIXED HARDWOODS, TREE FERNS or LAKE:*DYSTROPHIC.

Bordered-by (category 561)

If the community (category 520) is bordered by 2 different communities, the 2nd community and community type (if it applies) is (are) entered in this category using the same format entry as category 560.

Bordered-by (category 562)

If the community (category 520) is bordered by 3 different communities, the 3rd community and community type (if it applies) is (are) entered in this category using the same format entry as category 560.

Macrohabitat (category 580)

The gross community stratification and zonation, which is a coarse indicator of the horizontal and vertical layer in which ground beetles occur, is entered in this macrohabitat category. The 5 macrohabitat divisions presently used are CANOPY, UNDERCANOPY, SUPRA-EPIGEAN, EPIGEAN, and HYPOGEAN. CANOPY is entered if the specimen was associated with a tree crown in a forest community. UNDERCANOPY is entered if the specimen was found between the canopy and the ground in a forest community, such as associations with shrubs, vines, or fallen logs. SUPRA-EPIGEAN is associated with grass, shrubs, logs, and the like, in an open-area community such as cultivated land, fallow field, pasture-land, or savannah. EPIGEAN is entered for specimens found on the ground. HYPOGEAN is entered for underground associations.

Microhabitat (category 600)

A single word descriptor of the microenvironment with which the specimen is associated is entered in this category. The Study keeps a running glossary of microhabitat word descriptors so that consistency in recording data is maintained. Word descriptors commonly used in the Study are: ANT COLUMN, CARRION, CLAY, COBBLE, DEBRIS, DOMESTIC, DRIFT, DUNG, FLOWER, FOLIAGE, FOLIAGE-EPIPHYTE, FOLIAGE-FERN, FOLIAGE-GRASS, FOLIAGE-HERB, FOLIAGE-MOSS, FOLIAGE-SEDGE, FOLIAGE-SHRUB, FOLIAGE-TREE, FOLIAGE-VINE, FRUIT, FUNGI, GRAVEL, GUANO, HUMUS, LOAM, LEAF LITTER, MUD, NEST, ROOTS, SAND, SILT, SLASH, SOIL, STONE, SPIDER WEB, and WOOD.

Microhabitat Species Name (category 605)

The species name, or if not known, the common name of the microhabitat is entered in this category (if it applies). (e.g., If FOLIAGE is entered in category 600, and it is known that the species name is *Heliconia imbricata,* then HELICONIA IMBRICATA is entered in category 605; if STONE is entered in category 600, then the microhabitat species name category is left blank.)

Section of the Microhabitat (category 610)

The section of the microhabitat with which the specimen is associated is entered in this category. (For example, if WOOD is entered in category 600, possible entries would be TRUNK, BRANCH, TWIG. If FRUIT is entered in category 600, possible entries would be FLESH, SEEDS, SKIN. If FOLIAGE is entered in category 600, possible entries would be LEAF, PETIOLE, LEAF AXIL.)

Condition of Microhabitat (category 615)

Qualifiers for the condition of the microhabitat category are entered in this category (if applicable.) The Study keeps a running glossary of microhabitat word descriptors so that consistency in recording the data is maintained. (For example, if WOOD is entered in category 600, possible entries would be:

DRIFT
FALLEN, DEAD
FALLEN, LIVE
STANDING, DEAD
STANDING, LIVE

If FOLIAGE is entered in category 600, and LEAF is entered in category 610, possible entries would be:

WEBBED TOGETHER BY CATEPILLAR
UNROLLED YOUNG
DEAD

If FRUIT is entered in category 600, possible entries would be:

ADHERENT, DRY
ADHERENT, RIPE
ADHERENT, FERMENTING
DROPPED, DRY
DROPPED, UNRIPE
DROPPED, RIPE
DROPPED, FERMENTING)

Stratum of the Microhabitat Section (category 620)

The horizontal layer or section of the microhabitat is entered in this category. Common word entries are: ON, IN, UNDER, AMONG, FROM, UNDERSIDE (if FUNGI is entered in the microhabitat category), and BETWEEN (if LEAF AXIL is entered in the microhabitat section category). If WOOD is entered in category 600, possible entries would be:

BARK, ON
BARK, IN
BARK, UNDER
SAPWOOD
HEARTWOOD, IN

Activity of the Specimen (category 625)

The activity of the specimen prior to capture is entered in this category (e.g. FLYING, RUNNING, IN COPULA).

Microhabitat Remarks (category 630)

Microhabitat explanatory notes and remarks are entered in this category. If DEBRIS is entered in category 600, it is described in this category.

Collecting Method (category 700)

The method used to collect the specimen in its natural habitat is entered in this category. Collecting methods commonly used in the Study are BEATING, BERLESE FUNNEL, RAKING, SIFTING, SPLASHING, SWEEPING, and TREADING.

Attractants and Traps (category 720)

If specimens have been attracted or trapped, details of the method are entered in this category. This category differs from category 700 in that attractants and traps draw the insect away from its natural habitat. A single *word descriptor* of the attractant or trap is first entered in this category (e.g. BAIT, LIGHT, TRAP). A *colon* follows the attractant and trap word descriptor. If the word descriptor is less than 5 data characters, a *blank space* follows the colon (e.g. BAIT: *, LIGHT:). *Detailed word(s)* of the attractant and trap descriptor word is (are) entered in the 7th data character position; if there are more than one detail word, they are listed in order of dominance and separated by a blank space. (e.g.

LIGHT:UV,*TRAP
LIGHT:UV,*WHITE)

All labels which read "black light" are entered as "LIGHT:UV" Some attractant and trap data used in this Study are:

BAIT:*MALT, 2 DAYS OLD
BAIT:*MOLASSES
LIGHT:ARC-GLOBE
LIGHT:MERCURY VAPOR
LIGHT:UV
LIGHT:UV, WHITE
LIGHT:UV, TRAP
LIGHT:WHITE
TRAP:*CUT BRANCH
TRAP:*FRUIT FLY
TRAP:*FRUIT FLY, GLASS
TRAP:*PITFALL

Time of Activity (category 730)

The local time of day in which the specimen was observed active, in addition to the day phase is entered in this category. The *Diel* (24 hour) *Cycle* of recording time is used (using a leading zero, if necessary, to make a 4 digit number). A *blank space* follows the 4 digit time cycle and then either A, D, V, or N follows for *A*uroral, *D*iurnal, *V*esperal, or *N*octurnal (e.g. 1320*D).

Exposure (category 740)

The ILLUMINATION, GRADATION OF SLOPE, and the DIRECTION OF SLOPE are the 3 components of Exposure which are entered in this category. Each major category component has one data item entered from a choice of 3 or more.

They are:	They are formatted as:
ILLUMINATION	ILLUM-
OPEN	OPEN***
PARTIALLY-OPEN	P-OPEN*
CLOSED	CLOSED*
GRADATION OF SLOPE	GRAD-
FLAT	FLAT**
INTERMEDIATE	INTER*
STEEP	STEEP*

DIRECTION OF SLOPE	DIR-
NORTH	N
EAST	E
SOUTH	S
WEST	W
NORTHEAST	NE
NORTHWEST	NW
SOUTHEAST	SE
SOUTHWEST	SW

Illumination is entered in data character positions 1-6 as ILLUM-. Following the hyphen either OPEN***, P-OPEN*, or CLOSED* is entered in data character positions 7-13. "OPEN***" is entered if the microhabitat is openly exposed without any shade from trees or geological features, thus receiving the sun's full illumination, such as a tree trunk in the middle of cultivated land. "P-OPEN*" is entered if the microhabitat is in an open area receiving some source of shade during part of the day, such as a fallen log beneath a tree located in a fallow field. "CLOSED*" is entered if the microhabitat is situated in an area which does not allow penetration of sunlight, such as a log under a dense forest canopy.

Gradation is entered in data character positions 14-18 as GRAD-. Following the hyphen either FLAT**, INTER*, or STEEP* is entered in data character positions 19-24. "FLAT**" is entered for an exposed area that is at an approximate 10° level or less. "INTER*" is entered when an exposed area is approximately between an 11° and 22° slope. "STEEP*" is entered when an exposed area has a slope that is approximately 23° or more.

Direction is entered in data character positions 25-28 as "DIR-." Following the hyphen either N, S, E, W, NE, NW, SE, or SW is entered for the direction in which the slope faces the sun.

Example: ILLUM-OPEN***GRAD-INTER*DIR-SW

Topography (category 750)

The geological feature at which the specimen was collected is entered in this category. Some geological features used in the Study are CANYON, PLATEAU, RAVINE, and RIDGE. The geological feature is entered in the first 8 data character positions, followed by selected components and their descriptors. As an example, the selected components and descriptors for RAVINE are:

for RAVINE are:	They are formatted as:
SECTION	SEC-
HEAD section of ravine	HEAD**
MID section of ravine	MID***
MOUTH section of ravine	MOUTH*
STRUCTURE	STR-
SHALLOW	SHALLOW*
SLOPING	SLOPING*
STEEP	STEEP***
SIZE of ravine	SIZE-
	000*M*
VEGETATION of ravine	VEG-narrative

"SEC-" is entered for ravine section in data character positions 9-12. Following the hyphen either HEAD**, MID***, or MOUTH* is entered in data character positions 13-18. The section of the ravine is subjectively determined by the field person.

"STR-" is entered for ravine structure in data character positions 19-22. Following the hyphen either SHALLOW*, SLOPING*, or STEEP*** is entered in data character positions 23-30. These adjectives describe the walls of the ravine or canyon and are subjectively determined by the field person.

"SIZE-" is entered for the depth of the ravine in data character positions 31-35. A *3 digit* estimated *number* is entered (using leading zeros if necessary) in data character positions 36-38. A *blank space,* an *M,* and another *blank space* follows in data character positions 39-41.

"VEG-" is entered in data character positions 42-45. The vegetation of the ravine follows in data character positions 46, 47, etc. (An example of how ravine and its components are entered is: RAVINE**SEC-HEAD**STR-SHALLOW*SIZE-005*M*VEG-BUNCH GRASS, FERN, PROSTRATE HERBS, FERNS ON WALL, GRASS AND HERBS ON FLOOR).

Date Captured (category 800)

The date on which the specimen was collected is entered in this category using a date format commonly used at the National Museum of Natural History for computerized data processing: The format used is: *DAY* (2 digits), *blank space, MONTH* (first 3 letters of the month), *blank space, YEAR* (4 digits). If any part of the date is not available, hyphens are used to replace the incomplete datum. If the value of the day of the month is 1 to 9, a leading zero precedes the one digit number (e.g. 10*JAN*1944; 01*DEC*1940; 20*AUG*----). A range of dates follows the same format, except for an addition of a *blank space, TO* and another *blank space* (e.g. 10*JAN*1974*TO*11*JAN*1974). The Central American Study uses this format not only for the data file but also for specimen labels, thus eliminating confusion and mistakes caused by the misinterpretation of the day, month, and/or year as explained in Stuckenberg and Irwin (1973) and Frank (1974).

Collector(s) (category 810)

The surname and initials of the specimen collector are entered in this category. The *surname* is entered first, followed by a *comma* and the *initials.* Each initial is followed by a period. Designations such as "Jr." or "Sr." follow the initials (e.g. DARLINGTON,P.J.JR.). Multiple entries of names are separated by a semi-colon and a blank space (e.g. DARLINGTON,P.J.JR.;*LINDROTH,C.H.). Titles, such as "Dr.," "Captain," are not entered.

Field Book-Note Numbers and Habitat Photograph (category 820)

The field *book* number, the field *note* number (which combined designate a particular microhabitat), and a code to indicate whether a photograph of the habitat was taken is entered in this category. Field notes are kept in a 6 1/2 by 9 inch field book binder which has its own 2 digit binder number (using a leading zero if necessary). Each page is called a "note" and contains data on one microhabitat and has its own 3 digit number (using a leading zero if necessary). The book and note numbers are combined into a hyphenated 6 character field book-field note number code. Following this code, a "P" preceded by a blank space is entered if a photograph was taken of the area in which the microhabitat occurs (e.g. 01-011*P).

When filling out the field note forms, the locality and constant data items are incorporated onto a lead form. The notes which follow contain the specific microhabitat data. Lead notes and microhabitat notes have separate numbers. The last note in the series of microhabitat notes receives an encircled "E" (meaning end) located to the right of the 8 character code. The "E" is simply a double check on the numbers to make sure the variable microhabitat notes follow the correct lead or constant data items note.

Collector's Number (category 840)

Numbers on borrowed specimen labels which indicate that they are the collectors' field note number are entered in this category. These numbers are entered just as they appear on the label. If a large series of specimens from a collector is available, then the collector's numbers are formatted so that they are entered in specific data character positions (using leading zeros if necessary).

Expedition (category 850)

The name of the field expedition is entered in this category. Data relating to the expedition such as the museum or sponsor, the name of the expedition, and the date are included in this category (e.g. CMNH PANAMA EXPEDITION 1958).

Miscellaneous Remarks (category 999)

Explanatory notes and data which are not adaptable to any of the established categories are entered in this catch-all, miscellaneous remarks category (e.g. NO RAIN THE DAY SPECIMEN WAS COLLECTED; RIGHT HIND LEG MISSING WHEN COLLECTED; TEMPERATURE-054 F).

After a varied assortment of records have been accumulated from diversified sources (about 3,000 to 6,000 records), it is beneficial to review and analyze a listing of the miscellaneous remarks for patterns of consistent topics which require the creation of new standard categories.

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I especially thank: Terry L. Erwin, my husband, who provided raw data, direction, and continued encouragement throughout the development of this paper, and David Bridge who generously shared his expert advice in matters relating to SELGEM, data processing, and biological problems. Also much appreciated is the cooperation, help, and advice extended to the Study by the *entire* NMNH-ADP Program staff during the tenures of James F. Mello (first year of the Study) and T. Gary Gautier. Hearty thanks are also extended to the following people who read early drafts of the manuscript and offered excellent ideas for its improvement: Robert T. Allen, David Bridge, Arthur A. Brigida, Terry L. Erwin, T. Gary Gautier, Patricia M. Juell, James F. Mello, and Donald R. Whitehead. Thanks are also extended to George Venable for preparing figures 3 and 7 and for graphic assistance and advice with the other figures. And, to the numerous people who have made helpful suggestions in the course of the Study, *thank you all.*

NOTES

[1] SELGEM is the general purpose information management system developed at the Smithsonian Institution and used by the United States National Museum of Natural History and by many other museums. Information about application of SELGEM to museum collections is available from: Chief, The ADP Program, National Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560. Technical information on SELGEM's operating system is available from: Manager, Information Retrieval and Indexing, Office of Computer Services, Arts and Industries, Smithsonian Institution, Washington, D. C. 20560.

[2] This manuscript is a 102 page draft entitled *FILE-BUILDING: A Manual for Data Banking via SELGEM,* labelled "Smithsonian Institution Procedures in Computer Sciences VOL. I, Num 2, FEBRUARY 1973." Copies are available through Information Retrieval and Indexing, address in footnote 1.

[3] See section of paper entitled "Procedures for Preparing and Gathering Source Data."

[4] See the section of this paper entitled "Descriptions of categories used and how they are formatted and encoded for field note and for data processing."

[5] Note that the categories are grouped by subject matter and that intervals were designed for inclusion of subject related categories.

[6] The ADP specimen number/SELGEM serial number label (Fig. 3) which is on each Central American Ground Beetle specimen used in this Study is produced as follows: 1) A computer program was written to generate consecutive numbers below the acronym "ADP" (Automatic Data Processing). (The printing is done on white computer paper. Care is taken to use a *good* ribbon so that a sharp contrast of black ink on white paper is achieved); 2) The printout which has 4 characters per centimeter is photo reduced to make a negative with 9 characters per centimeter; 3) The negative is then used to print copies on 100% rag content paper; and 4) The labels are cut and applied to each pinned specimen or put into the alcohol specimen vial before data are entered into the computer.

[7] To maintain a continuous work flow for the Study's needs, each species is assigned a generic name and epithet number to be used until the specimens can be compared to type material, when epithet numbers are changed to names.

[8] The field note form and the category formats should also be useful to non-computer oriented Coleopterists as an example of how field notes can be structured to maximize efficiency and accuracy in gathering and recording field data.

[9] The specimen number serves the same purpose as do catalogue numbers assigned to type specimens in large insect collections or to catalogue numbers assigned to specimens in disciplines other than Entomology.

[10] Here and elsewhere in the text, an asterisk (*) is used to denote a blank space; on the field note form (Fig. 1) the blank space is indicated by a Greek *delta.*

[11] The first phase of the Study will deal mostly with adults. More advanced phases of the Study will allow for in depth natural history studies involving all life history stages, at which time this category may need to be expanded to allow for greater details of each stage.

[12] Some of the following examples are in columnar form, as visual support for stressing comparative formats for data character positions or to visually illustrate involved formatting. For those examples which do not need visual support, horizontal lists are used.

[13] The placement of such areas as the CANAL ZONE are entered arbitrarily according to personal preference, and may not accurately reflect political attachment. The Central American Ground Beetle Study arbitrarily enters PANAMA in the Country category, and the CANAL ZONE in the Department/District/Province category.

[14] Frequently the Department/District/Province datum is not available on the specimen labels and has to be incorporated into the file subsequent to the original data entry. A special report can be produced from the computer, listing all the locality data in any requested order. In a report made for the Central American Ground Beetle Study, the Country, Department/District/Province, General Locality, and Specific Locality were listed in columns in alphabetical order. If the province had been entered into the file, it was listed in the province column of the report; if not, a blank area occurred between the country and the general locality. The province for each general locality need be looked up only one time. Then by using data processing methods, province is entered only once followed by all the specimen numbers/SELGEM serial numbers pertaining to specimens from this general locality. The computer then inserts in the file the appropriate province for each specimen record.

[15] For the Central American Ground Beetle Study, *riparian* specifically refers to a relationship with a river, stream, creek, brook, or run.

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GLOSSARY

The following terms and definitions are either from glossaries listed in the references cited or have been altered or developed for clarity in reading this paper.

Category (sensu SELGEM)
One or more data elements. In the SELGEM system a category is identified by a 3 digit number.

Data
A representation of facts or concepts suitable for communication, interpretation, or processing by human or automatic means. Singular form, DATUM.

Data Bank (or **Data Base)**
A comprehensive collection of *files* of data. For example, several *categories* comprise a *record,* a set of records forms a *file,* and the files used by a researcher or group of mutual interest researchers are known as their *data bank.*

Data Character Position
When a data item(s) is (are) formatted, the field of data must start and end in specified locations. Each location within the field has a special identifying address known as the data character position.

Data Element
A basic unit of identifiable and definable information. It has an identifying name and value or values for expressing a specific fact (e.g. Country, Date, Collecting Method, Community, Microhabitat).

Data File
A collection of related data records organized in a specific manner and treated as a unit.

Data Item
The expression of a particular fact in a category, e.g. "Neotropical" may be the data item in the Zoogeographic Region category.

Field
A specified area within a category used for a particular data item.

Formatted Information
An arrangement of information into discrete units and structures, to facilitate access and processing; in contrast, narrative information is arranged according to rules of grammar.

Header-Partial Data Entry
A method used to speed the data input process by reducing keystrokes. All constant data are typed into one "header" record, and the variable data are entered into "partial" records which are strung behind the "Header" record (which for this Study is on paper tape). A SELGEM program adds the header data to each partial record producing complete specimen records in the file.

Leading Zeros
When a field for a data item is formatted for a specific number of numeric positions (digits), leading zeros are added to the left of the number when the number has less than the required number of digits. For example, if a field requires 4 digits, the number 10 would have 2 leading zeros addedeft, thus it would read: 0010.

Master File
A collection of related records which is altered infrequently and supplies basic data for processing operations.

Optical Character Recognition (OCR)
A method of encoding data for computer processing. Data are typed on a special typewriter which has an optical character recognition element.

The OCR typed copy is machine read through the use of light-sensitive devices.

Record (Unit Record, *sensu* SELGEM)

A collection of categories of data, treated as a unit. For the Central American Ground Beetle Faunal Study, a specimen record contains all the categories of data for a particular specimen.

SELGEM

The acronym for *SEL*f-*GE*nerating *M*aster. SELGEM is the information management system developed at the Smithsonian, consisting of over 25 general purpose computer programs. This storage, management, and retrieval system was designed especially for collection management in museums and to handle natural history data.

Serial Number

In the SELGEM system, an 8 character number used to identify a record.

Source Data

For this paper, "source data" refers to data from specimens, specimen labels, and field notes.

Unit Tray

For the non-entomologist who may read this paper, a unit tray is a small topless box with a special bottom that firmly holds the insect pins, and in which the insects are housed. Several unit trays of insects are housed in an insect drawer. Several drawers are housed in an insect cabinet.

* * *

A METHOD FOR REARING GROUND BEETLES (COLEOPTERA: CARABIDAE)

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Abstract

A method for rearing large numbers of immature ground beetles is described. This method was successful for beetles from various northern Nearctic habitats, representing more than 80 species in 29 genera. Details are given for collection and care of gravid females, oviposition, incubation, rearing, and preservation. Success depends on providing a suitable environment, meticulous care, and perseverance.

Described below are techniques for rearing large numbers of immature ground beetles from eggs laid by field-collected adults. The success of the method depends upon providing a fitting environment for the beetles. The environment described here has proved satisfactory for rearing larvae of many different species parents collected in habitats ranging from the vicinity of glacial ice to agricultural fields. This method is similar to that described by Thiele (1968). More than 80 species representing the following genera have been reared, using this method (! indicates that some or all species were reared at least to 3rd instar): *Metrius, Carabus*!, *Calosoma*!, *Scaphinotus*!, *Sphaeroderus*!, *Nebria*!, *Pelophila*!, *Opisthius*!, *Blethisa*!, *Elaphrus*!, *Loricera*!, *Miscodera, Patrobus*!, *Diplous*!, *Platypatrobus*!, *Asaphidion, Bembidion*!, *Pterostichus*!, *Calathus*!, *Synuchus*!, *Platynus*!, *Rhadine, Agonum*!, *Amara*!, *Harpalus*!, *Bradycellus, Trichocellus, Chlaenius*!, *Metabletus*!. I was able to successfully rear 70 to 90% of all eggs used.

Collecting gravid females: Females with distended abdomens are sought in the field at time of oviposition. If tenerals (freshly emerged adults with soft, pale cuticles) of a given species occur in late summer, adults generally oviposit in spring. If tenerals occur in late spring or very early summer, oviposition takes place in mid-summer. If oviposition time is not known then gravid females may be collected when adults are most abundant. As a test, a few females are dissected and ovaries examined for degree of development.

The collected females must be kept cool to preserve their reproductive capacity. Containers must be kept out of direct sunlight at all times. Beetles can be transported to permanent quarters in picnic coolers with ice. Finally, specimens should not be overcrowded as this may inhibit egg laying.

Oviposition: Collected beetles should be transferred as soon as possible to oviposition boxes with about 1 cm of sifted moist soil (sand, loam, organic forest soil, or preferably peat moss) or very moist absorbent paper. The soil is moist enough when water stops pouring out when squeezed moderately by hand. Some females oviposit in granular substrates (field and forest species) while others readily accept moist absorbent paper (marsh-inhabiting species). Small containers should have air-tight lids; larger containers need not. I usually keep 2 males and 8 females in a box with a surface area of about 100 cm², but females may be kept separate in smaller boxes with or without a male. I use transparent plastic boxes so that the beetles react to a proper day length (artificial or natural). I usually feed the beetles immediately with *Tenebrio* larvae, as some females have a tendency to eat their own eggs if hungry. Since ground beetles rarely attack insects with hard cuticle I cut the *Tenebrio* into 5 pieces and give each adult one piece every other day.

Eggs may be found a few hours after the females are placed in the oviposition boxes. They may be collected immediately or any time up to a week after which they start to hatch, or they may be left in the oviposition box and young larvae collected later. For exact data about oviposition rate, the following procedure is sufficient. If females oviposit on moist absorbent paper, eggs may be counted at each time interval and then the moist paper replaced. If females of the species being studied oviposit on soil only, they are allowed to oviposit on moist sand and the eggs are collected by a flotation method (Southwood, 1966). If eggs must be kept alive, a saturated sugar solution instead of a salt solution may be used for flotation, but the collected eggs should be washed in cool water to remove the sugar coating.

Incubation of eggs: Eggs must be on a moist substrate in a cool environment; 20°C is excellent for rapid, successful development. The substrate should be a thin layer of peat moss (5 mm) over which a moist piece of paper is placed with eggs. If every larva is required for further study, the following may help to avoid cannibalism. Place a thin rectangular piece of plastic in a vial so that the corners of the plastic project onto the walls of the vials (Fig. 1). The piece of plastic serves as a small table on which is placed a moist paper with eggs. This paper must be kept moist during the incubation period. This vial is stabilized and a solution of detergent and water (3-4 drops of detergent to about one cup of water) is added to a depth

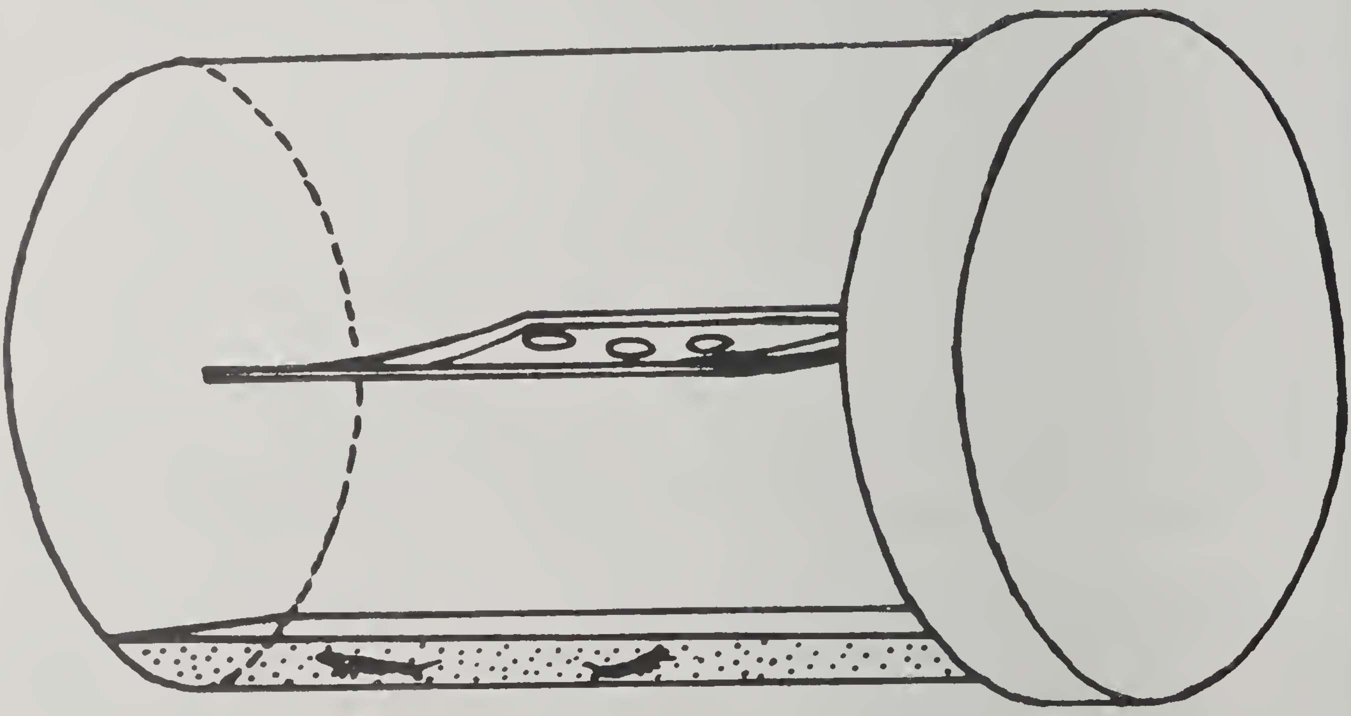

Fig. 1. Incubation box for eggs designed to avoid cannibalism. The eggs are on a moist paper over a rectangular piece of thin plastic which does not touch the back or front of the box. At the bottom is a diluted detergent solution.

of 4-5 mm. The vial is then closed with an air-tight lid. As the larvae hatch, they soon walk and reach the edge of the plastic table where they fall into the solution, sink, and become inactive. If the solution is kept around 15 to 20°C, the larvae remain alive for 12 hours. When transferred to moist paper they become active again after a few minutes.

For success in incubation, a few special points should be noted. Dead, fungused eggs should be removed daily; if not, the fungi attack healthy ones. Eggs must be handled with great care, preferably with a moist paint brush. Eggs generally hatch at the same time for each species if kept under similar conditions. The appearance of pigmented mandibles indicates that eggs at 20°C should generally hatch within 24 hours.

Rearing of larvae and pupae: This step is generally the most difficult and often results in total failure. The work is time consuming, but if the principles previously mentioned are kept in mind excellent results should normally follow. Most of the work results from the need to rear larvae singly because of their cannibalistic habits. For each medium size larva I use a small, shallow container 20 to 30 mm in diameter (Fig. 2) and with a 1-4 mm layer of moist peat moss; with early instar larvae I use less peat moss because they are hard to find at each check. A piece of *Tenebrio* larva is put along the edge of the container on an area of slightly compacted peat moss, helping the larva to find the food easily as it walks around the walls of the container. Finally the larva is carefully transferred to the container which is closed with an air-tight lid to preserve moisture. The food must be changed daily at 20°C or every other day at lower temperatures to avoid fungi. Fungi attack and kill larvae, so any contaminated food and substrate should be changed. The larvae are very pale after molting, so if exuviae are to be collected the peat moss must be carefully searched soon after moulting. If larvae of the species studied overwinter or enter diapause, use conditions reproducing natural ones (day length and temperature). While larvae are in diapause, check the container weekly to provide oxygen. Near pupation the larva builds a cell in which it lies supine. This inactivity begins 5 to 7 days before pupation at 20°C. The pupa is kept in the larval container, and any contaminated peat moss is replaced. Pupae should be checked every 2 to 4 days.

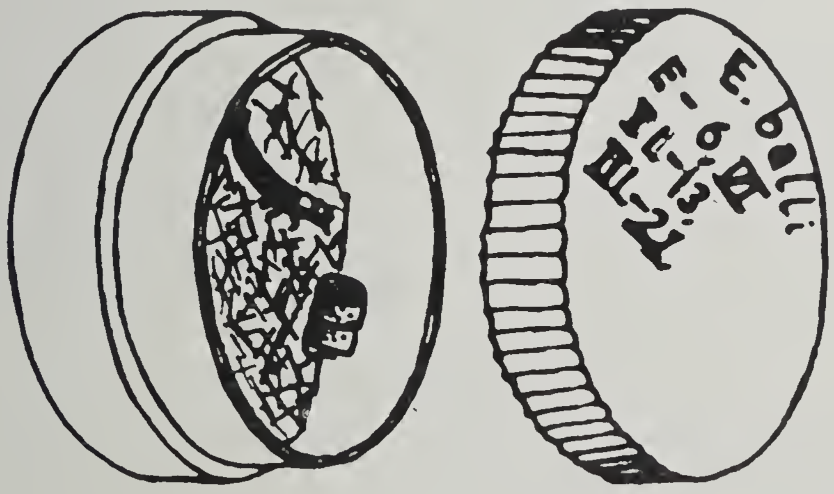

Fig. 2. Typical rearing box used for larvae and pupae showing the food position and the layer of moist peat moss.

Cool, moist conditions must be maintained, the food supply should be renewed every day or every other day, the environment must be free of fungi and mites, and the larvae and pupae must be handled very gently (I use fine forceps).

Keeping adults and reproduction: Adults are treated in the manner described for field-collected females. However, teneral individuals must not be kept with older adults for the former are easy prey in their soft condition. If adults are kept for reproduction, diapause needs (if any) must be satisfied. Each species may have its own special requirement in this respect.

Preservation of immature stages: To obtain straight larvae for preservation, place in near boiling water while alive (or recently dead), then let the water cool. In about 5 minutes the larvae are straight and ready to be stored in 70% alcohol.

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A REVISION OF THE NORTH AMERICAN SPECIES OF *METOPHTHALMUS* (COLEOPTERA: LATHRIDIIDAE)

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Abstract

The widespread genus *Metophthalmus* Wollaston is recharacterized, and the 8 North American species are keyed, described, and illustrated. Biological notes are given for the western species. *M. albosignatus* Fall, 1899, is placed in synonymy with *M. americanus* Motschulsky, 1866. *M. haigi* (type-locality Silverthorne, Shasta Co., California), *M. kanei* (type-locality Laguna Seca, Monterey Co., California), and *M. sandersoni* (type-locality Washington Co., Arkansas) are described as new.

Introduction

The genus *Metophthalmus* Wollaston is 1 of 11 North American genera included in the tribe Lathridiini. The generic name *Metophthalmus* refers to the eyes, which appear superior because of the lateral extension of the gena (fig. 1); this character can be used to separate the genus from all other Lathridiidae. The genus occurs in the Nearctic, Neotropical, Palearctic, and Ethiopian regions but appears to be most common in the temperate areas of North America, southern Europe and northern Africa. Included in the genus are 36 described species; 8 are North American, and 3 are new.

The 1st species described in the genus *Metophthalmus* was *M. asperatus* Wollaston, 1854 (type by monotypy), from the Madeira Islands, 400 miles off the northern coast of Africa. The 2nd species described and the 1st from North America was *M. parviceps* LeConte, 1855. The next North American species was *M. americanus* Motschulsky 1866; the unique type probably is in Russia, and has not been seen by any worker since Motschulsky. Fall (1899) monographed the genus in North America and added 3 species (*M. albosignatus, M. rudis* and *M. trux*). There has been no additional work since Hatch described *M. septemstriatus* from Oregon in 1962. Hammad (1953) described the immature stages of *M. serripennis* Broun, 1914, a species introduced into England from New Zealand in commerce.

Individuals of *Metophthalmus* are small (1.0 mm to 1.8 mm), reddish-brown beetles that live in ground litter where they feed on fungi. They usually are heavily coated with a chalky wax-like exudate that obscures the rugosities of the head and pronotum. The small size, cryptic coloration, and obscure habitat have resulted in few collections and a resultant poor representation of these beetles in collections.

Acknowledgements

I wish to express my appreciation to the following individuals and institutions for the loan of specimens. Abbreviations will be used to indicate the repository of specimens. American Museum of Natural History (AMNH); California Academy of Sciences (CASC); University of Califor-

nia, California Insect Survey (CISC); Canadian National Collection of Insects (CNCI); California State University at Long Beach (CSLB); Cornell University Insect Collection (CUIC); Insect Collection at Illinois State Natural History Survey (INHS); Joe Schuh, Klamath Falls, Oregon (JSCC); Museum of Comparative Zoology, Harvard University (MCZC); Oregon State University, Department of Entomology Collection (OSUO); California State University at San Jose (SJSC); University of California, Davis (UCDC); University of California, Riverside (UCRC); United States National Museum (USNM).

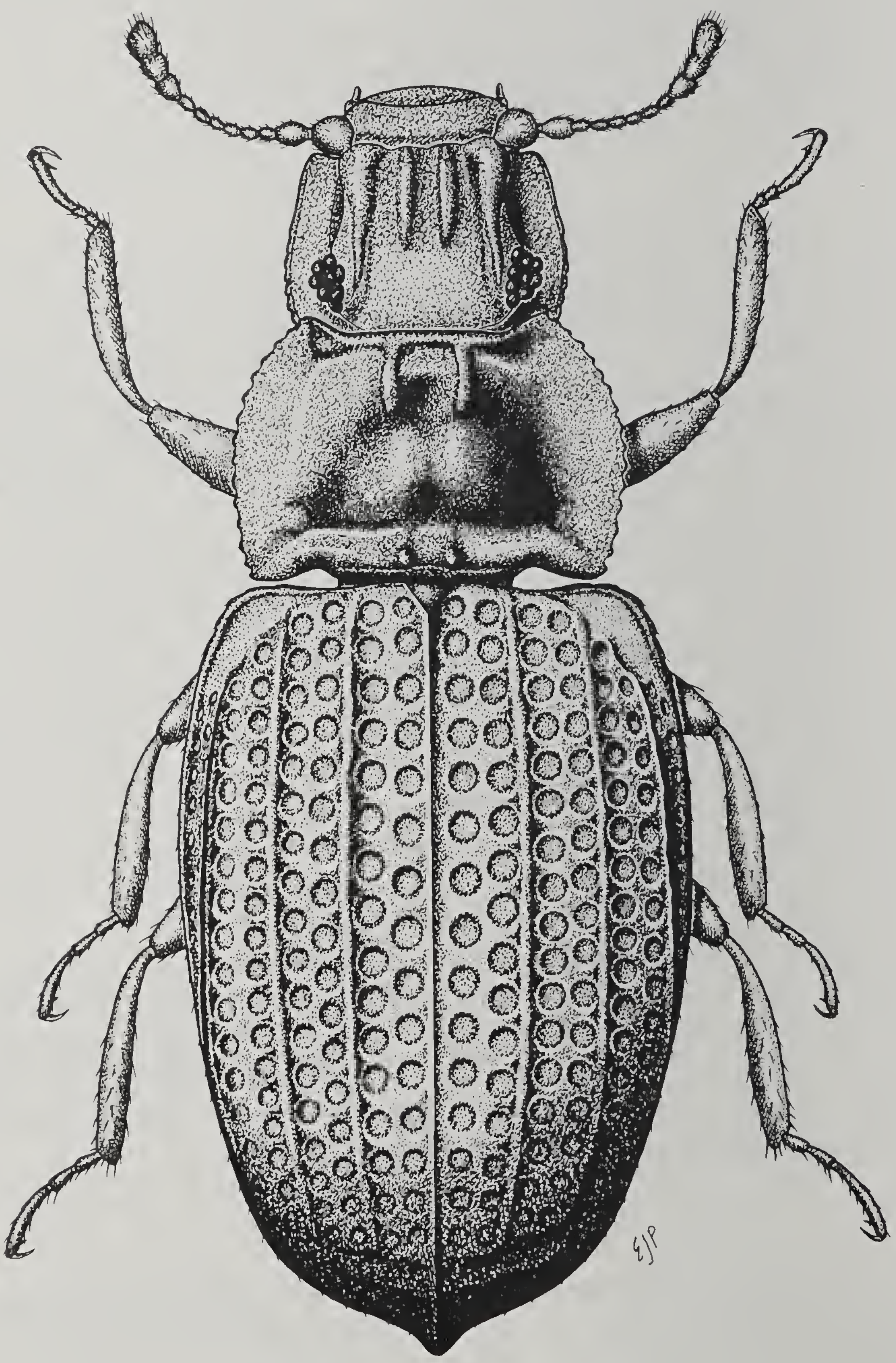

Fig. 1. Dorsal view of *Metophthalmus rudis* Fall.

Special appreciation goes to Dr. J. F. Lawrence, Museum of Comparative Zoology, for making available the lathridiids associated with higher fungi from his collection; Dr. E. L. Sleeper, California State University at Long Beach, for allowing me to sort through alcohol samples of berlese material from Southern California and Baja California Norte, Mexico; Dr. I. M. Newell, University of California, Riverside, for allowing me to sort through his alcohol samples from Southern California; Mr. D. Giuliani, Big Pine, California, for running berlese samples from various localities on the east side of the Sierra Nevadas; Messrs. E. A. Kane, T. R. Haig, R. F. Wilkey, and R. Hobza, California Department of Food and Agriculture, who collected litter samples throughout California; Dr. A. R. Hardy for reading the manuscript; and to Ms. K. S. Corwin who prepared slide mounted specimens, collected litter samples, and helped in preparation of the manuscript.

METHODS

Several papers suggest techniques that allow the waxy white covering to be softened and then removed with fine needles. The small size of these beetles makes this difficult and time consuming. I have found that ½ to 2 hours immersion in turpentine followed by washing in xylene and then absolute ethyl alcohol will satisfactorily clean specimens. Longer exposure to turpentine will cause a darkening of the integument.

If the beetles are to be slide mounted, the exudate can be removed in the clearing process. Specimens are placed in cold 10% KOH for 48 hours and then gently heated for 20-30 minutes in Essig's Aphid Fluid. The wax exudate will go into solution when heated in the EAF, but round globules will precipitate out and adhere to the specimen if the specimen is left in the fluid while cooling, therefore immediate transfer to cellosolve is recommended. Critical morphological analysis is possible only when specimens are slide mounted with exudates removed.

All measurements given were taken from slide mounted specimens. Pronotal outlines were made from tracings of photographs. Numbers of punctures in elytral striae 7-8 are most accurately determined by using cleared specimens in solution, but can be done with pointed specimens.

BIOLOGY

Little is known about the life history of these beetles. Hinton (1941) cites collection of *M. hispidus* Belon from tobacco in Chile and *M. serripennis* Broun from warehouse storage in England. Hammad (1953) gives life history details of *M. serripennis* Broun reared on fungal cultures in the laboratory.

I have successfully reared *M. kanei* n. sp. on fungal cultures generated by inoculating agar culture plates with extracts from litter samples. In these mixed-fungi cultures the beetles avoided all but 1 fungus, which may indicate specific food preference. Both larvae and adults grazed on the spores and hyphae of the fungi. Lawrence (in litt.) has on several occasions taken adults from fruiting bodies of higher fungi, but never in the numbers that can be found in litter.

The rarity of specimens in collections is an artifact of collecting technique. In nature they are relatively abundant and may be collected in numbers by berlese funnelling litter samples.

Berlese sampling of litter from various California localities has led to a generalized picture of the habitat of *Metophthalmus* in California (fig. 2). On the map, closed circles represent samples containing *Metophthalmus* and open circles represent samples without *Metophthalmus*. All positive samples west of the Sierra Nevada have 2 things in common; they come from the lower to mid-elevation foothills, and are in oak areas. East of the Sierra Nevada, several samples containing *Metophthalmus* did not contain oak litter.

The data from the berlese survey of litter indicated a correlation between the presence of *Metophthalmus* and an oak litter substrate. This correlation was tested by pairing oak against each of the 3 most commonly occurring litter producers in *Metophthalmus* areas.

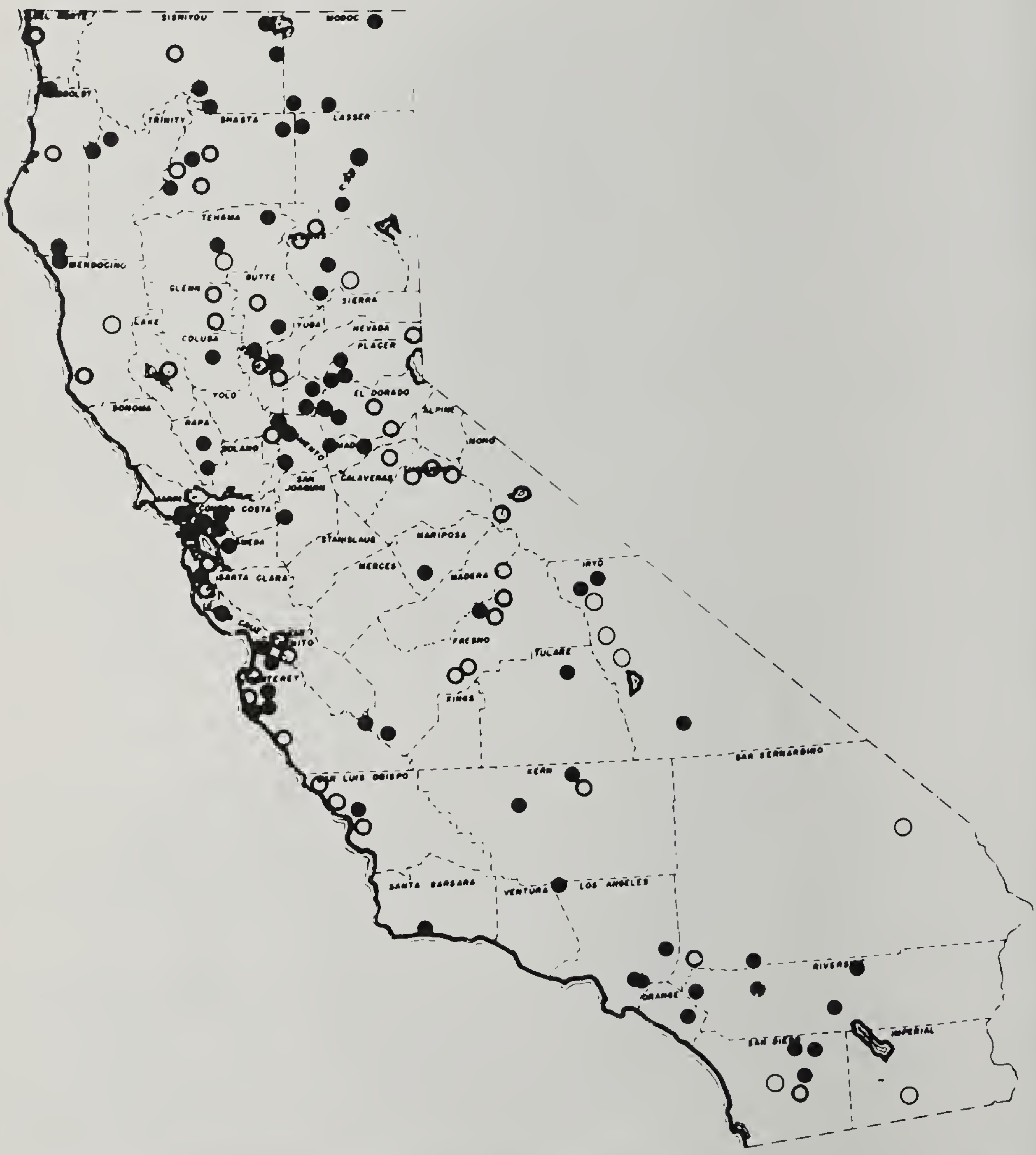

Fig. 2. Distribution of litter collection sites in California. Berlese samples positive (dot) or negative (circle) for *Metophthalmus* sp.

Three sites were chosen from widely separated locales, each with a different species of *Metophthalmus* dominant. Site I was in El Dorado County with *M. parviceps* dominant, but with *M. trux* not uncommon; Site II was in Tulare County with *M. trux* the dominant species; and Site III was in Monterey County with *M. kanei* the only species present. The 4 litter producing plants, Oak, Pine, *Arctostaphylos,* and *Ceanothus,* were present at each site.

Nine comparisons were made at each site. Each comparison consisted of 3 litter samples (1 cu. yd.); 1 of pure oak litter taken beneath an oak standing relatively isolated from other litter producing plants, 1 of the litter producing plant being compared to oak, and 1 of mixed litter taken where an oak and the alternative litter producing plant were growing together. The 3 litter samples for each comparison were usually taken within 50 feet of each other, and in no case more than 200 feet apart. Three comparisons of oak × pine, oak × *Arctostaphylos* and oak × *Ceanothus* were made at each site. In total, 27 litter samples were berlesed from each site. The 27 samples were all within 200 yards of each other.

Table 1 depicts the results, each notation represents a single litter sample. In no case was *Metophthalmus* recorded from a sample without oak. This, combined with the fact that almost all general samples positive for *Metophthalmus* contained oak, appears to demonstrate the dependence of *Metophthalmus* on oak litter substrate. It is likely that the oak controls the presence or absence of certain fungi, probably by a pH factor.

Oak litter contains a relatively depauperate Coleoptera fauna and often only contains lathridiids. If the samples are extremely damp, ptiliids replace the lathridiids. Staphylinids, carabids and tenebrionids are often present, but not consistently or in large numbers.

Substrate Types

	OAK	MIXED	PINE
SITE 1	+	+	-
2	+	+	-
3	+	-	-
	OAK	MIXED	CEANOTHUS
SITE 1	+	+	-
2	+	+	-
3	+	+	-
	OAK	MIXED	ARCTOSTAPHYLOS
SITE 1	+	+	-
2	+	-	-
3	+	+	-

Table 1. The occurrence of *Metophthalmus* as a function of litter composition. (+) Berlese sample contained *Metophthalmus*; (-) Berlese sample void of *Metophthalmus*.

KEY TO NORTH AMERICAN *Metophthalmus*

1. Elytron with 6 rows of striae 2
1′. Elytron with 7 or 8 rows of striae 5

2(1). Antenna 10-segmented .... *parviceps* LeConte
2′. Antenna 11-segmented 3

3(2′). Trochanter elongate cylindrical, length twice width .... *americanus* Mots.
3′. Trochanter width subequal to length 4

4(3′). Median carina of head extending from frons to vertex; pronotal cup complete .... *trux* Fall
4′. Median carina of head present in anterior ½ of head only; pronotal cup effaced except for anterior lateral points .... *sandersoni* n.sp.

5(1′). Elytron with 7 rows of striae .... *septemstriatus* Hatch
5′. Elytron with 8 rows of striae 6

6(5′). Pronotal cup complete; median carina of head extending from frons to vertex .... *haigi* n.sp.
6′. Pronotal cup effaced except for anterolateral points; median carina present in anterior ½ only 7

7(6′). Pronotum broadly arcuate (fig. 10); limited to coastal areas south of San Francisco Bay .... *rudis* Fall.
7′. Pronotum subsinuate (fig. 9); distribution non-costal .... *kanei* n.sp.

Genus *Metophthalmus* Wollaston

(meta = "on top of", ophthalmus = "eye")

Description: Small, length 1.0-1.8 mm, elongate-oval, depressed, usually partially covered with chalky-white exudate. Head an elongate trapezoid, narrowed anteriorly, front with 2 well-defined lateral costae, with or without 2 median costae bisecting frons; eyes small, lateral, near occiput, composed of few large facets; genal area laterally flanged, extending beyond eyes, eyes appearing superior; clypeus and labrum elongate-rectangular, divided by distinct suture, clypeus meeting truncate frons on lower plane. Antenna 10- or 11-segmented, scape large and globular, pedicle smaller and globular, flagellum 5-6 segmented, segment 3 widest at base, 4-7 or 8 moniliform and widest apically, 3 terminal segments forming distinct club. Mouthparts concealed by expansion of mentum into large rectangular plate; plate excavated at anterior corners, circular labial palps form corners of plate; maxillary palp 3-segmented, 1st small, quadrate, 2nd large, expanded distally, 3rd small, cylindrical, dense setae terminally, galea with forward edge armed with large hooklike setae. Mandible toothed distally, with prostheca and molar area. Occiput rounded, slightly constricted to short neck. Pronotum transverse; lateral margins explanate, serrulate, arcuate to sinuate; disk with quadrate cup complete or partially effaced; coxal cavities closed. Elytra oval, dorsally flat or slightly inflated, each with 6-8 rows of striae formed by large deep punctures, glabrous, apical angles explanate, serrate. Sternum glabrous, with or without sparse small punctations, mesothorax and metathorax with or without pit. Abdomen 6-segmented. Coxae globose. Legs short, each with femur moderately expanded medially; tibia narrow, cylindrical; tarsus 3-segmented, terminal segment elongate. Male genitalia simple, tape-like or sclerotized tube.

Metophthalmus trux Fall, 1899

Description: Length 1.2-1.6 mm. Width 0.3-0.5 mm. Body elongate, subparallel; flat in profile; glabrous. Cutical shining; pale reddish brown; dorsal exudate limited to low relief areas of pronotum and underside of body except terminal abdominal segment. Lateral carinae distinct, partially obscuring eyes when viewed from above; median carinae complete, subparallel. Genal flange arcuate, gradually expanded posteriorly; slightly longer than wide. Frons obliquely truncate. Clypeus wide, blending into genal flange. Labrum short. Pronotum explanate, lateral margins minutely serrulate, slightly expanded in anterior half (fig. 4); pronotal cup complete; pronotal collar entire. Elytra 6-striate; punctures uniform in size; sutural striae 18-punctate; interspaces 3 and 5 distinct only apically; humeral flange narrow in apical ⅓; coxae globular; trochanter ham-shaped; femora elongate-ellipsoidal, hooked around trochanter basally. Metasternal pits rectangular between coxae, reduced to 2 distinct pockets on mesal edge of coxae on first abdominal sternite. Male genitalia elongate, tape-like.

TYPE: S. B. Mts., Cal. 8.10.92; M.C.Z. Type 24496. Fall did not label a type. I am designating this specimen as lectotype.

Material examined: CALIFORNIA—Amador Co.: 3 mi. S. Michigan Bar, 14-IV-72, F. G. Andrews, oak duff [CDAE] (2); Pine Grove, 5-III-71 and 28-III-71, F. G. Andrews, oak duff [CDAE] (5). Butte Co.: Chico, 4-XII-72, T. R. Haig [CDAE] (1); Wyandotte, 24-X-71, F. G. Andrews, oak duff [CDAE] (1). El Dorado Co.: 2 mi. E. Cameron Park, 12-X-70, F. G. Andrews, oak duff [CDAE] (2); El Dorado, 18-VII-71, F. G. Andrews [CDAE] (2). Fresno Co.: 10 mi. N.E. Auberry, 31-I-66, J. Prine, *Arctostaphylos* litter [CDAE] (1); 11 mi. W. Coalinga, 28-X-71, F. G. Andrews, oak duff [CDAE] (13); 15.8 mi. W. Coalinga, 16-XI-71, F. G. Andrews, oak duff [CDAE] (2). Humboldt Co.: Kneeland School, 30-IV-73, T. R. Haig, oak duff [CDAE] (1); Redway, 1-III-72, T. R. Haig, moss [CDAE] (1). Inyo Co.: Westgard Pass, XI-72, D. Giuliani, pine duff [CDAE] (2). Lassen Co.: 7 mi. W. Nubieber, 13-I-72, T. R. Haig, oak duff [CDAE] (4). Los Angeles Co.: Brown's Flats, San Gabriel Mts., 20-XI-58, 1-II-59, 2-I-60 and 13-II-60, M. Knox and E. L. Sleeper [LBSC] (14). Modoc Co.: 10 mi. W. New Pine Creek, 20-V-60, W. Cooper, Manzanita litter [UCDC] (1). Monterey Co.: Arroyo Seco P.C., 30-XII-61, E. L. Sleeper [LBSC] (2); Cachagua Road, 4 mi. S.E. Carmel Valley, 3-III-72, F. G. Andrews and K. S. Corwin [CDAE] (1); 2 mi. S.E. Carmel Valley, 31-III-72, F. G. Andrews, K. S. Corwin, oak duff [CDAE] (1); 2.1 mi. S. Carmel Valley, 9-V-73, F. G. Andrews, oak duff [CDAE] (1); 1 mi. N. Jamesburg, 31-III-72, F. G. Andrews and K. S. Corwin, oak duff [CDAE] (1); Salmon Creek, 2 mi. E. Hwy 1, 10-IX-69, J. D. Pinto, duff [UCRC] (1); 19.4 mi. E. San Lucas, 16-XI-71, Fred G. Andrews, oak duff and *Heteromeles arbutifolia* duff [CDAE] (9); 19.8 mi. E. San Lucas, 28-X-71, F. G. Andrews, oak duff [CDAE] (1); 20.9 mi. E. San Lucas, 16-XI-71, F. G. Andrews, oak duff [CDAE] (2); 20.9 mi. E. San Lucas, 24-III-72, E. A. Kane, *Heteromeles* litter [CDAE] (9). Napa Co.: Lower Chiles Valley Rd. and Hwy. 128, 28-VI-71, F. G. Andrews [CDAE] (1); Intersection of Chiles and Lower Pope

Valley Rds., 1-XI-72, F. G. Andrews, oak duff [CDAE] (1); 2 mi. E. Napa, 4-II-71, W. W. Wiard, oak duff [CDAE] (1). Placer Co.: 2 mi. W. Auburn, 3 mi. S. Auburn and 10 mi. N. Auburn, 8-XI-70, 17-I-71 and 10-X-71, R. F. Wilkey, oak duff [CDAE] (18); 5 mi. S.W. Auburn, 10-X-71, F. G. Andrews, oak duff, [CDAE] (5); Rocklin, 6-XI-71, F. G. Andrews and E. A. Kane, oak duff [CDAE] (6). Riverside Co.: 2 mi. N.W. Gilman Hot Springs, 21-IV-64 and 16-V-65, Fred G. Andrews, [CDAE] (3); Gilman Hot Springs, 7-XI-72, F. G. Andrews, and E. A. Kane, *Neotoma* nest [CDAE] (5); Pinyon Wells, 14-V-66, E. L. Sleeper and S. L. Jenkins [CDAE] (1); Strawberry Creek, San Jacinto Mts., 22-II-73, I. M. Newell, leaf litter [UCRC] (6). Sacramento Co.: Carmichael, 19-I-71, R. F. Wilkey, oak duff [CDAE] (1); Elk Grove, 15-III-71 [CDAE] (2); Rio Linda, 20-II-71, R. F. Wilkey, oak duff [CDAE] (21). San Benito Co.: 15 mi. S. Paicines, 16-XI-71, F. G. Andrews, oak duff [CDAE] (13). San Bernardino Co.: 1.8 mi. W. Jenks Lake, 23-III-58, I. M. Newell, black oak litter [UCRC] (1); Seven Oaks, 26-I-63, I. M. Newell, dry oak litter [UCRC] (1). San Diego Co.: Borrego, Palm Canyon, 25-IV-55, R. O. Schuster [CISC] (3). San Francisco Co.: San Francisco, 2-XII-06, E. C. Van Dyke [CASC] (1). San Luis Obispo Co.: Pennington Creek Res., 17-X-68, R. Delameter [CDAE] (1). Santa Cruz Co.: Ben Lomond, 5-VII-53, C. D. MacNeil [CISC] (1). Shasta Co.: Silverthrone, 28-II-71, T. R. Haig, live oak and manzanita duff [CDAE] (1). Shasta Co.: Whiskeytown, 9-III-72, T. R. Haig, oak duff [CDAE] (1); 3 mi. S. Whiskeytown, 31-I-73, T. R. Haig [CDAE] (14); Whiskeytown, 16-IV-73, T. R. Haig [CDAE] (1). Siskiyou Co.: 3 mi. N. Dunsmuir 23-II-70 and 31-V-72, T. R. Haig, oak duff [CDAE] (2). Sutter Co.: Sutter Buttes, 8-XI-71, E. A. Kane, oak duff [CDAE] (2). Tehama Co.: Paynes Creek, 24-XI-72 and 31-XII-72, T. R. Haig, oak duff [CDAE] (13); 4 mi. N. Red Bluff, 22-XI-71, T. R. Haig, oak duff [CDAE] (1). Trinity Co.: 5 mi. E. Salyer, 19-III-71, T. R. Haig, [CDAE] (2). Tulare Co.: Kaweah, 16-XI-71, F. G. Andrews, oak duff [CDAE] (6); Kaweah Power Station, 16-XI-71, F. G. Andrews, oak duff [CDAE] (2). OREGON—Benton Co.: Scott's Hill, 1 mi. S.W. Corvallis, 26-III-59, J. D. Lattin, grass and moss [OSUO] (3). Josephine Co.: Rough and Ready St. Pk., 2 mi. N. O'Brien, 20-V-60, J. D. Lattin, moss [OSUO] (1). Klamath Co.: Bly Mountain, 5-V-61, J. Schuh, willow duff [JSCC] (1). OKLAHOMA—Osage Co.: IBP Comprehensive Site, 11-VII-71, R. C. Reed, ungrazed area [KSUC] (1). TEXAS—Brown Co.: Brownwood, 19-VIII-37, L. D. Christenson [USNM] (1). Colorado Co.: Columbus, 14-VIII, Hubbard and Schwarz [USNM] (2). MEXICO—Baja Calif.: Cerralvo Island, 16-IV-62, R. Banks, *Ganoderma zonatum* [MCZC] (1).

Remarks: This species may be separated from all other North American *Metophthalmus* by the 6-striate elytra, a complete median carina on the head, and a complete pronotal cup. Also distinctive is the broad, subparallel pronotum.

M. trux is the most widely distributed North American species, extending from the Pacific Northwest through California into Baja California, and into Texas and Oklahoma (fig. 11). The interspecific variation is small in spite of the extended distribution. A single specimen in the Fall type series from Columbus, Texas, has an effaced median carinae on the head. The specimen is teneral and the difference probably developmental.

Metophthalmus americanus Motschulsky, 1866

Metophthalmus albosignatus Fall, 1899. **New Synonomy**

Description: Length, 1.0-1.1 mm. Width, 0.2-0.3 mm. Body feebly subparallel, flat; glabrous. Cuticle moderately shining, pale testaceous;

elytra with slightly darker mottled areas; legs and antennae uniformly testaceous. Heavy encrustation of white exudate on anterior surface of head, pronotum, lateral margins of elytra, a patch approximately 2 punctures wide extending from edge of elytron 2/3 of the way back, nearly to suture, and entire underside except legs, trochanters and last 1 or 2 abdominal segments. Head slightly longer than wide; slightly arcuate lateral carina from base of antenna to midpoint of eye; median carinae almost totally effaced; short lateral carina extending from base of eye halfway to antennal insertion; genal flange not extending beyond eyes. Eyes large, tempora wanting. Antennae 11-segmented, transverse, 11 subequal in length to 9 and 10. Clypeus broadly truncate. Labrum slightly indented, gently arcuate. Pronotum wider than long by ratio of 4:3; anterior ½ arcuate, posterior ½ subparallel (fig. 4); pronotal cup effaced except for anterolateral nodes. Elytra oval; 6 striae; punctures large with 16 in sutural row; interspaces 3 and 5 distinctly carinate; humeral flange almost obsolete. Coxae oval; trochanters elongate-cylindrical, more than twice as long as wide; femora ellipsoidally expanded. Metasternal pit rectangular except anterior corners slightly projected and shallow; pits in 1st abdominal segment limited to 2 small pockets adjacent to mesal side of coxae. Male genitalia elongate, tape-like.

TYPE: Mobile, Alabama. I have not studied Motschulsky's type of *M. americanus,* but I feel confident that the description fits the specimens of *M. albosignatus* I have studied. Additionally, the Gulf Coast distribution fits with *M. albosignatus.* Following is a translation of Motschulsky's Latin description.

> Metophthalmus americanus *Motsch., elongate, convex, hairless, reddish-brown, small black eyes, antennae and legs marbeled red; head narrow, frons bisected by furrow; thorax broader than head, explanate, uneven, anteriorly obliquely attenuated, dorso-posteriorly with two folds and two deep impressions, laterally angulate at middle, posterior corners forming right angles; elytra broader than thorax, elongate-elliptical, convex, with deep pits arranged in lines and alternate with narrow keels, shoulders rounded.*
>
> *Length 1/2 line*, width 1/5 line**
>
> *Smaller, narrower and less tapering than Met. lacteolus.*
>
> *I have caught it at the feet of trees in Mobile, Alabama in North America.*
>
> *A line equals 1/12 an inch, therefore 1/2 line = 1mm and 1/5 line = 0.4mm.

The entire description fits the *M. albosignatus* material, but the size and pronotal shape are shared by no other described New World species.

Material examined: FLORIDA—Alachua Co.: Gainesville, 7-XII-26, W. B. B. [PURC] (1). Dade Co.: Biscayne, 21-V, 24-V and 31-V, Hubbard and Schwarz [USNM] (7); Homestead, 1919, Schwarz and Barber, *Zamia* flowers [CUIC] (24); Upper Key Largo, 12-XI-72, C. W. and L. B. O'Brien, hammock litter [CDAE] (3). Highlands Co.: 4 mi. S.E. Lake Placid, 30-VI-65, J. F. Lawrence, *Polyporus* sp. (*s.lat.*) [MCAC] (2). Pinellas Co.: St. Petersburg, 24-VI, Hubbard and Schwarz [USNM] (2).

Remarks: The elongate cylindrical trochanters at once differentiate this species from other North American species, all of which have a short club-shaped trochanter. The distinctive cylindrical trochanters cast doubt on its placement in this genus. The world-wide generic concepts of the Lathridiini are at this point poorly defined, and the only means of placing the genera is a key by Hinton (1941). In this key, *M. americanus* would fall into *Eufallia* primarily on the similar shape of the trochanters. Species of *Eufallia,* however, differ greatly from *M. americanus* in general form, shape of pronotum, filamentous antennae, and lack of genal projection. The general form of *M. americanus,* the antennal character, genal projection, and shape of pronotum all are as in North American *Metophthalmus* and dictate its present placement in the genus.

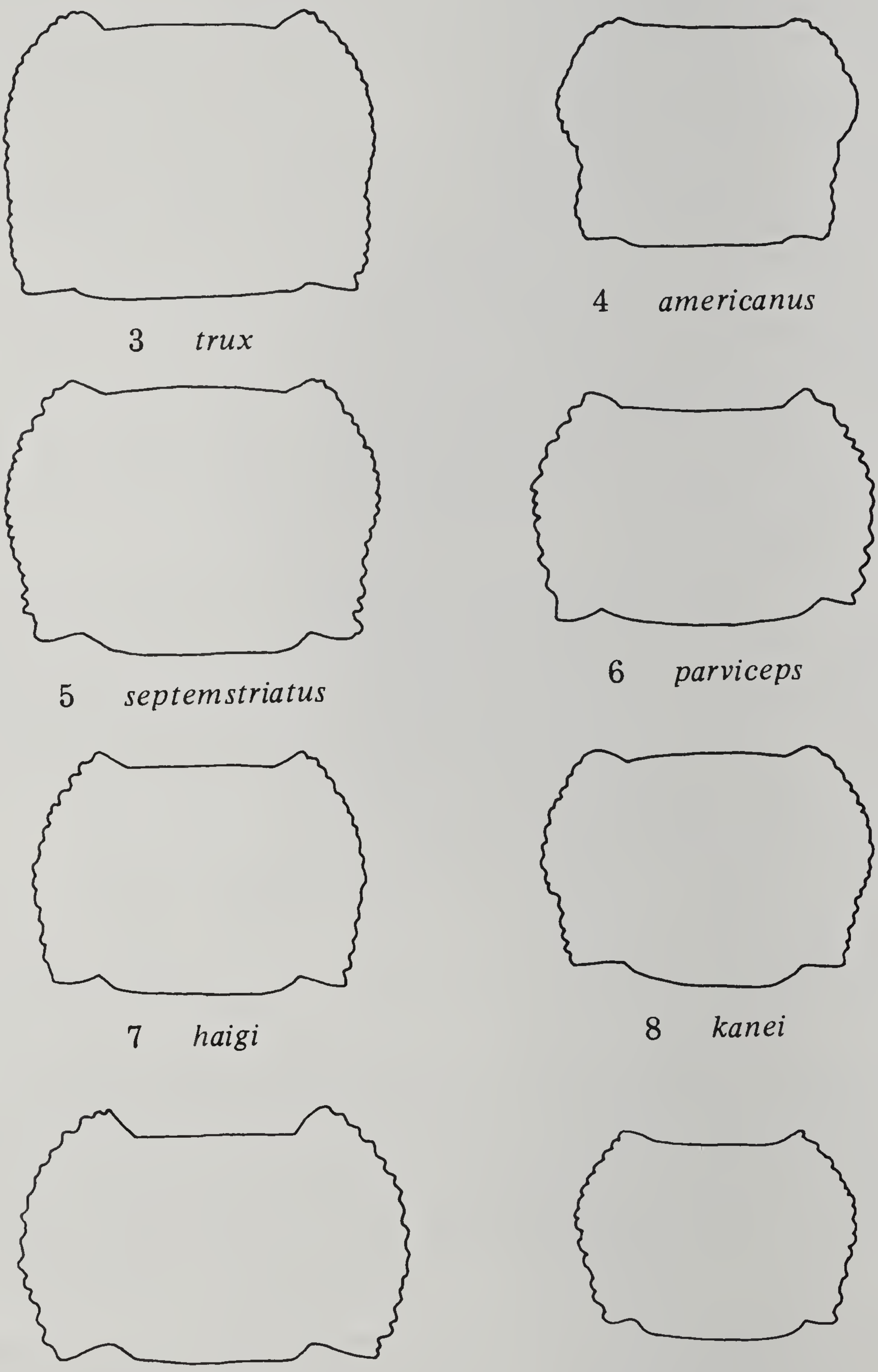
3 *trux*
4 *americanus*
5 *septemstriatus*
6 *parviceps*
7 *haigi*
8 *kanei*
9 *rudis*
10 *sandersoni*

Fig. 3-10. Pronotal outlines of North American species of *Metophthalmus.*

The only known collections of this species have been along the Gulf of Mexico (fig. 13), and in association with *Zamia* sp. and *Sideroxylon mastichodendron* Jacq. It is possible that *M. americanus* is the northern extension of a more tropical element of the genus and has its affinities with neotropical forms. Unfortunately, I have not been able to study neotropical material.

Metophthalmus septemstriatus Hatch, 1962

Description: Length, 1.2-1.8 mm. Width, 0.4-0.5 mm. Body elongate; subparallel; flat in profile; glabrous. Cuticle shining, dark reddish brown; exudate limited to thin layer between carina on head and heavy coating on pronotum, humeral flange, and under surface of body. Head short; lateral carinae complete; median carinae complete, diverging slightly towards vertex; lateral carina extending from midpoint of eye to antennal insertion. Tempora wanting. Genal flange parallel with head, barely extending beyond eyes; margin serrulate. Antennae 11-segmented; segments 4-8 moniliform, as wide as long, 9 slightly longer than wide, 10 transverse; apical segment 1.5 times longer than wide. Anterior margin of frons concave. Clypeus laterally rounded, embracing frons. Labrum rounded. Pronotum sinuate, margins serrulate; anterior ½ of pronotal cup entire (fig. 5); pronotal collar without nodes. Elytra 7-striate; punctures uniform in size throughout; interspaces 3 and 5 slightly raised; sutural stria with 17 punctures; humeral flange explanate, anterior corners produced, with several nipple-like setiferous projections. Coxae oval; trochanters distinctly longer than wide, femora compressed and ellipsoidal. Area between metacoxae deeply indented with diagonally extending projections into metasternum. Sutures behind 1st and 2nd abdominal sternites deep. Male genitalia elongate, tape-like, with sclerotization and curvature at terminal ⅓.

TYPE: McMinnville, Yamhill Co., Oregon, 27-X-1933, K. M. and D. M. Fender [CASC].

PARATYPE: Oregon, Benton Co., Corvallis, 15-V-1949, V. Roth, fir needles [OSUO] (1).

Material examined: ARIZONA—Cochise Co.: Rustler Park, 8 mi. W. Portal, 3-VIII-61 and 8-VIII-61, J. F. Lawrence, *Hirshioporus abietinus* and *Larcifomes officinalis* [MCZC] (3). Pima Co.: Catalina Mts., 27-VII-17, 7500-7800 ft. [CUIC] (7). CALIFORNIA—Alameda Co.: Berkeley, 10-III-19, J. O. Martin, wood rat nest [CASC] (1); Berkeley, 19-XII-19 and 11-II-20, H. Dietrich, *Pinus radiata* [CUIC] (2); Oakland, 7-VII-61, J. F. Lawrence, *Coriolus versicolor* [MCZC] (2); Tilden Park, 8-X-60, J. F. Lawrence, *Coriolus versicolor* [MCZC] (1); U. C. Botanical Gardens, 28-X-62, W. J. Turner [WSUC] (1). Contra Costa Co.: Walnut Creek, VI-60, G. Pieper [CISC] (1). Los Angeles Co.: Pasadena, II, A. Fenyes [CASC] (9). Marin Co.: Mill Valley, various dates throughout year, H. B. Leech [CASC] (89). Mariposa Co.: Head of E. Fork Piney Creek, 2-IV-64, H. B. Leech, cynipid gall [CASC] (1). Mendocino Co.: 1 mi. S. Piercy, 14-V-61, J. F. Lawrence, *Fomitopsis pinicola* [MCZC] (1). Monterey Co.: Big Sur, 14-V-60, J. F. Lawrence, *Coriolus versicolor* and *Lenzites betulina* [MCZC] (2). Napa Co.: Lower Chiles Valley Road and Hwy. 128, 11-X-70 and 28-VI-71, Fred G. Andrews [CDAE] (9). Plumas Co.: Nr. Camel Peak, 24-IX-55, H. Ruckes, Jr., *Pinus lambertiana* cones [CISC] (1). Santa Cruz Co.: Ben Lomond, 25-II-62, J. F. Lawrence, *Fomitopsis pinicola* [MCZC] (1). Tulare Co.: Nr. Little Baldy, Sequoia Nat. Park, 21-IX-55, H. Ruckes, Jr., *Pinus lamber-*

tiana cones [CISC] (1). Oregon—Benton Co.: Corvallis, 15-V-49, V. Roth, fir needles [OSUO] (1). Canada—British Columbia: Green River Campsite, 9-VIII-68, J. Borden, *Cryptoporus volvatus* [CNCI] (1).

Remarks: *M. septemstriatus* was described by Hatch (1962) from a series taken in Oregon. Dr. Hatch apparently saw 2 long series from the San Francisco Bay area on deposit in the California Academy of Sciences, but did not mention them in the original description.

This species is not uncommon in samples taken in coastal California in the San Francisco Bay area, but is very rarely taken in the Sierra Foothills (fig. 12). Specimens from Arizona are slightly larger and the sculpture less pronounced.

M. septemstriatus is unique in having the elytra with 7 rows of striae; however, the lateral margins of the elytra are often heavily encrusted, obscuring the striae. The combination of the entire median carinae of the head and incomplete pronotal cup are needed to separate it from the very similar and sympatric *M. haigi* and *M. kanei.*

Metophthalmus parviceps LeConte, 1855

Description: Length, 1.0-1.3 mm. Width, 0.3-0.5 mm. Body subparallel; humped in profile; glabrous. Cuticle shining; granulose between punctures; reddish brown. Dorsal area head and pronotum (except for lateral margins), flange of elytra, underside (except mouthparts), coxae, legs and terminal segment of abdomen obscured by chalky exudate. Head with lateral carinae subparallel, extending from frons to vertex; median carinae effaced except for anterior remnant. Tempora wanting. Genal flange arcuate, rounded, extending well beyond eyes; lateral margin with 5-6 setiferous papilliform projections. Antennae 10-segmented with 3-segmented club; segments 5, 6, 7 transverse. Clypeus truncate. Labrum evenly rounded, contiguous with lateral margins of clypeus. Pronotum wider than long by ratio of 31:21; broadly explanate and evenly arcuate laterally with 16 ±1 setiferous papilliform projections (fig. 6); pronotal cup effaced except for anterolateral nodes. Elytra subparallel, 6-striate, interspaces 3 and 5 slightly raised; sutural punctae 16; punctae of striae 1 and 2 appreciably larger than those of 3-6; humeral flange distinct, bearing setiferous, nipple-like projections anteriorly. Coxae rounded; trochanters ham-shaped, slightly longer than wide; femora compressed and expanded, subrectangular. Metasternal pit deep, form rectangular with anterolateral fingers; metasternum and first abdominal segment fused between coxae. Male genitalia elongate, tape-like.

Type: A LeConte type with a gold disk indicating California. Fall, 1899 indicates San Jose, Santa Clara Co. as the type locality, but it is not indicated on the type. MCZ Type 6995.

Material Examined: California—Alameda Co.: county record only, IV, A. Koebele [USNM] (1). Butte Co.: Chico, 4-XII-72 and 2-V-73, T. R. Haig, oak duff [CDAE] (2). Colusa Co.: 2 mi. N. Colusa, 29-II-72, F. G. Andrews, oak duff [CDAE] (2). El Dorado Co.: 2 mi. E. Cameron Park, 12-X-70, F. G. Andrews, oak duff [CDAE] (4). Lake Co.: 9 mi. E. Clearlake Oaks, 29-III-73, T. R. Haig, oak duff [CDAE] (7). Lassen Co.: 7 mi. W. Nubieber, 13-I-72, T. R. Haig [CDAE] (2). Marin Co.: Mill Valley, 13-X-54, 17-XII-54 and spring-55, H. B. Leech, burrs of *Castanopsis chrysophylla* [CASC] (22); Mill Valley, 14-VI-52, H. B. Leech, *Neotoma* nest [CASC] (2). Modoc

Co.: Day, 2-III-73, T. R. Haig [CDAE] (1). Napa Co.: Lower Chiles Valley Rd. and Hwy. 128, 28-VI-71, F. G. Andrews [CDAE] (1); 2 mi. E. Napa, 4-II-71, W. W. Wiard, oak duff [CDAE] (1). Placer Co.: 2 mi. W. Auburn, 8-XI-70, R. F. Wilkey, oak duff [CDAE] (39); 10 mi. N. Auburn, 18-III-71, R. F. Wilkey, oak duff [CDAE] (4); 2 mi. W. Colfax, 14-X-71, E. A. Kane, oak duff [CDAE] (1); 2 mi. W. Foresthill, 2-II-72, F. G. Andrews, oak duff [CDAE] (3). Plumas Co.: 4 mi. S. San Benito P.O., 16-XI-71, F. G. Andrews, oak duff [CDAE] (1). San Mateo Co.: county record only, A. Koebele [CASC & USNM] (13); Hubbard and Schwarz [USNM] (1). Shasta Co.: Fall River Mills, 2-V-72, T. R. Haig, oak duff [CDAE] (1); 3 mi. S. Whiskeytown, 31-I-73, T. R. Haig [CDAE] (4); 3 mi. S.E. Whiskeytown, 9-III-73, T. R. Haig, oak duff [CDAE] (6); Whiskeytown, 16-IV-73, T. R. Haig [CDAE] (5). Siskiyou Co.: 3 mi. N. Dunsmuir, 31-V-72, T. R. Haig, oak leaves [CDAE] (1). Tehama Co.: Paynes Creek, 31-XII-72, T. R. Haig, oak duff [CDAE] (3). Tulare Co.: Kaweah, 16-XI-71, F. G. Andrews, oak duff [CDAE] (2). OREGON—Jackson Co.: 15 mi. E. Ashland, 23-III-62, Vertrees and Schuh, oak duff [JSCC] (1).

Remarks: *M. parviceps* is the only North American species with 10-segmented antennae. It is frequently taken in berlese samples with *M. trux* and *M. septemstriatus,* but is easily distinguishable by its small size and very heavy encrustation of exudate.

The known distribution (fig. 14) is not easily explained. While it is common for the San Francisco Bay Area to be the northern or southernmost extension of a species, it is not common for the distribution of a species to be truncated in the mid-Sierras.

Metophthalmus haigi Andrews, **new species**

Description: Length, 1.1-1.3 mm. Width, 0.3-0.4 mm. Body elongate, parallel; flat in profile; glabrous. Cuticle shining, pale reddish brown; exudate dorsally limited to low profile areas of prothorax, ventrally covering entire surface except for legs and terminal abdominal segments. Head elongate, narrow; lateral and median carinae entire, distinct. Genal flange straight, minutely serrate, produced laterally same distance as eye. Antennae 11-segmented; segments 4-8 moniliform. Pronotum laterally explanate, margins evenly serrulate, sinuate (fig. 7); pronotal cup complete. Elytra 8-striate; sutural striae 1-4 appreciably larger than 5-8; interspaces 3 and 5 slightly carinate apically; humeral flange strongly produced basally. Coxae globular; trochanter short; femora moderately expanded, hooking back around coxae. Deep metasternal pit between coxae; diagonal fingers extending to midpoint of metasternum. Male genitalia sclerotized and arcuate.

TYPE: Silverthorne, Shasta Co., California, 9-VI-1971, oak duff, T. R. Haig. Type to be deposited in California Academy of Sciences.

PARATYPES: Same data except III-27-1971 (1), VI-9-1971 (6), V-2-1971 (6); paratypes to CASC, USNM, MCZ.

Material examined: CALIFORNIA—Fresno Co.: 10 mi. N.E. Auberry, 31-I-61, J. Prine, *Arctostaphylos* duff [CDAE] (1); 20.9 mi. W. Coalinga, 16-XI-71, F. G. Andrews, *Neotoma* nest and oak duff [CDAE] (1). Inyo Co.: 5 mi. E. Big Pine, 28-IV-53, G. A. Marsh and R. O. Schuster [UCDC] (1); White Mts., 28-VIII-65, O. Clarke, *Populus trichocarpa* duff [UCRC] (13). Kern Co.: 4 mi. N. Altasierra, 28-IV-74, J. Doyen, *Polyporus volvatus* [CISC] (14). Lassen Co.: 7 mi. W. Nubieber, 13-I-72 and 18-IV-72, T. R. Haig, oak duff [CDAE] (2); 3 mi. N. Susanville, 18-IV-72, T. R. Haig, oak duff

[CDAE] (4). Los Angeles Co.: S. Slope Angeles Nat'l. Forest, 7-IV-57, I. M. Newell [UCRC] (1); Brown's Flats, San Gabriel Mts., 30-IX-58 and 1-II-59, M. Knox and E. L. Sleeper [LBSC] (2); 2 mi. S.E. Gorman, 28-X-71, E. A. Kane, oak duff [CDAE] (3); Pasadena, A. Fenyes [CASC] (1); San Dimas Exp. For., 19-XII-59, 2-I-60 and 23-I-60, M. Knox and E. L. Sleeper [LBSC] (4). Mariposa Co.: Mariposa, 4-IV-56, R. O. Schuster [UCDC] (1). Modoc Co.: Day, 2-III-73, T. R. Haig, [CDAE] (1). Riverside Co.: Mt. San Jacinto, 20-IV-58, I. M. Newell, *Artemisia* [UCRC] (1); Pinyon Wells, 4-III-67, E. L. Sleeper and S. L. Jenkins [LBSC] (1); Prado Dam, 4-V-63, I. M. Newell, oak duff [UCRC] (2); 10 mi. E. Redlands, 3-X-65, R. Ryckman, *Neotoma* nest [UCRC] (3). San Benito Co.: 15 mi. S. Paicines, 16-XI-71, F. G. Andrews, oak duff [CDAE] (11). San Bernardino Co.: Cajon Canyon, 17-IV-57, I. M. Newell, Joshua Tree, *Artemisia* and pine duff [UCRC] (1). San Diego Co.: Borrego, Palm Cyn. and Sheep Cyn., 25-IV-55 and 27-IV-55, R. O. Schuster [UCDC] (4). Shasta Co.: Silverthrone, 27-III-71, 2-V-71, 9-VI-71 and 26-II-72, T. R. Haig, oak duff, manzanita and pine duff, and oak leaves [CDAE] (16); 3 mi. S. Whiskeytown, 31-I-73, T. R. Haig [CDAE] (8); Whiskeytown, 16-IV-73, T. R. Haig [CDAE] (2). Siskiyou Co.: Lava Beds Nat'l Mon., 3-III-61, 6-IV-61 and 26-V-61, J. Schuh and E. Hansen, pack rat nest [JSCC] (4); W. side Tulelake, 15-IV-71, J. Schuh and J. Bailes, pack rat nest [JSCC] (4). Sutter Co.: Sutter Buttes, 8-XI-71, E. A. Kane, oak duff [CDAE] (1). NEVADA—Washoe Co.: Little Valley, 1970, N. Stark, Jeffrey pine litter, 6600 ft. [USNM] (1).

Remarks: This species has 8 elytral striae and in Fall's revision keys to *M. rudis*. It is quite distinctive and may be separated from the other 8-striate species, *M. rudis* and *M. kanei,* by the complete pronotal cup and entire median carinae on the head. It is interesting that in spite of its wide distribution (fig. 17) and abundance in recent collecting, it was represented by a single specimen from Pasadena when Fall revised the group, and was identified as *rudis*?

Morphologically, *M. haigi* has little variability throughout its range. One character is varied geographically. Elytral striae 7 and 8 are distinct posteriorly, but anteriorly only a single row of punctures is present. This short row, which I refer to as striae row 7+8, varies in the number of punctures. The northern specimens from Shasta, Lassen and Modoc Counties have 4-5 punctures, whereas all specimens from more southern localities have 1 or 2 punctures. This difference, although consistent and absolute, does not seem to merit nomenclatural status as it appears to be of less importance than the differences used to separate other species. Additional studies may indicate differently, so I am restricting the type series to those specimens having 4-5 punctures and occurring in Shasta and Lassen Counties.

This species is named for Survey Entomologist Mr. T. R. Haig of the California Department of Food and Agriculture who made the first collection and has brought me many litter samples from various areas in California.

Metophthalmus kanei Andrews, **new species**

Description: Length, 1.1-1.2 mm. Width, 0.3-0.4 mm. Identical to *Metophthalmus rudis* with the following exceptions: Head with median carinae present in anterior 3/4. Lateral margins of pronotum less arcuate, anterior angles less produced (fig. 8). Pronotal cup effaced except anterolateral ½; anterior margins only partially effaced.

TYPE: Laguna Seca, Monterey Co., California, X-29-1971, oak duff, Fred G. Andrews. Type to be deposited in California Academy of Sciences.

PARATYPES: 165 specimens same data. Paratypes to be deposited in CASC, USNM, MCZC.

Material examined: CALIFORNIA—Alameda Co.: Berkeley, 2-X-19 and 8-I-20, H. Dietrich [CUIC] (14); Berkeley, 23-X-62, J. T. Doyen, *Lepiota* [CISC] (4); Oakland, 3-II-51, N. A. Lewis [SJSC] (1); Redwood Canyon, 6-I-20 and 1-II-20, J. O. Martin [CASC & SJSC] (28); Tilden Park, 12-III-61, J. F. Lawrence, *Sternum hirsutum* [MCZC] (1). Monterey Co.: Arroyo Seco P.C., 30-XII-61, E. L. Sleeper [LBSC] (6); 2 mi. S. E. Carmel Valley, 31-III-72, F. G. Andrews and K. S. Corwin, oak duff [CDAE] (2); 2 mi. S. Carmel Valley, 9-V-73, F. G. Andrews, oak duff [CDAE] (4); 10 mi. N.E. Castroville, 29-X-71, F. G. Andrews, oak duff [CDAE] (14); Laguna Seca, 29-X-71, 8-I-72 and 31-III-72, F. G. Andrews, oak duff [CDAE] (24); Mill Creek, 28-X-71, F. G. Andrews, oak, bay and incense cedar duff [CDAE] (1); Salmon Creek, 2 mi. E. Hwy. 1, 10-IX-69, J. D. Pinto, duff [CDAE] (1). San Luis Obispo Co.: 7 mi. N.E. Morro Bay, 28-X-71, F. G. Andrews, oak duff [CDAE] (4). San Mateo Co.: Jasper Ridge, 18-I-48, S. Hildebrant [CASC] (3). Santa Barbara Co.: Refugio, 3-IV-72, D. Tieman, oak duff [CDAE] (1).

Remarks: To adequately diagnose this species and separate it from the closely related *rudis* Fall is most difficult. Variations in several characters do not seem to follow any large scale geographical pattern, but these characters are relatively constant in local populations. These variable characters include the number of punctures in elytral striae row 7+8 and the form of the pronotum.

M. kanei is considered distinct from *M. rudis* Fall because: (1) The form of the pronotum is more arcuate and the anterior projection of the pronotum is more strongly produced (fig. 8); (2) the number of punctures in elytral stria 7+8 is most frequently 4-5 as opposed to 6 and more in *M. rudis*; and (3) the geographical distribution (fig. 15) (coastal side of Coast Ranges) correlates with the previous characters.

M. kanei may be distinguished from the other 8-striate species, *M. haigi,* by the effaced posterior ½ of the median carinae of the head and the pronotal cup reduced to anterior lateral nodes. In *M. haigi* the median carinae are complete as is the pronotal cup.

While most *Metophthalmus* are not abundant in the field, *M. kanei* is extremely abundant locally. Litter samples taken at Laguna Seca, Monterey Co., Calif. have had as many as 500 beetles per 1½ cubic feet of litter. All known collections of this species are from litter containing oak leaves.

This species is named after my friend, the late E. A. Kane, who spent many hours collecting duff samples both for me and with me.

Metophthalmus rudis Fall, 1899

Description: Length, 1.3-1.5 mm. Width, 0.4-0.5 mm. Body elongate oval; humped in profile; glabrous. Cuticle dull, dark reddish brown. White chalky exudate lightly covering dorsum, heavily covering low profile areas of pronotum, humeral flange and undersurface, except legs and terminal abdominal segment. Head subquadrate; lateral carinae distinct in anterior half. Genal plate with lateral margins evenly arcuate, minutely serrate, extending well beyond eye. Antennae 11-segmented; segments 4, 5, 6 longer than wide. Pronotum wider than long by ratio of 3:2; lateral margins evenly serrate, broadly, evenly arcuate; anterior angles strongly produced (fig. 9); pronotal cup reduced to anterolateral nodes; pronotal collar distinctly binodal. Elytra 8-striate; sutural striae 18-punctate; interstrial spaces 3 and 5 moderately distinct; puncture size gradually diminishing from inner to outer striae; humeral flange wide, basally produced. Coxae oval, trochanter wider than long, meeting femora diago-

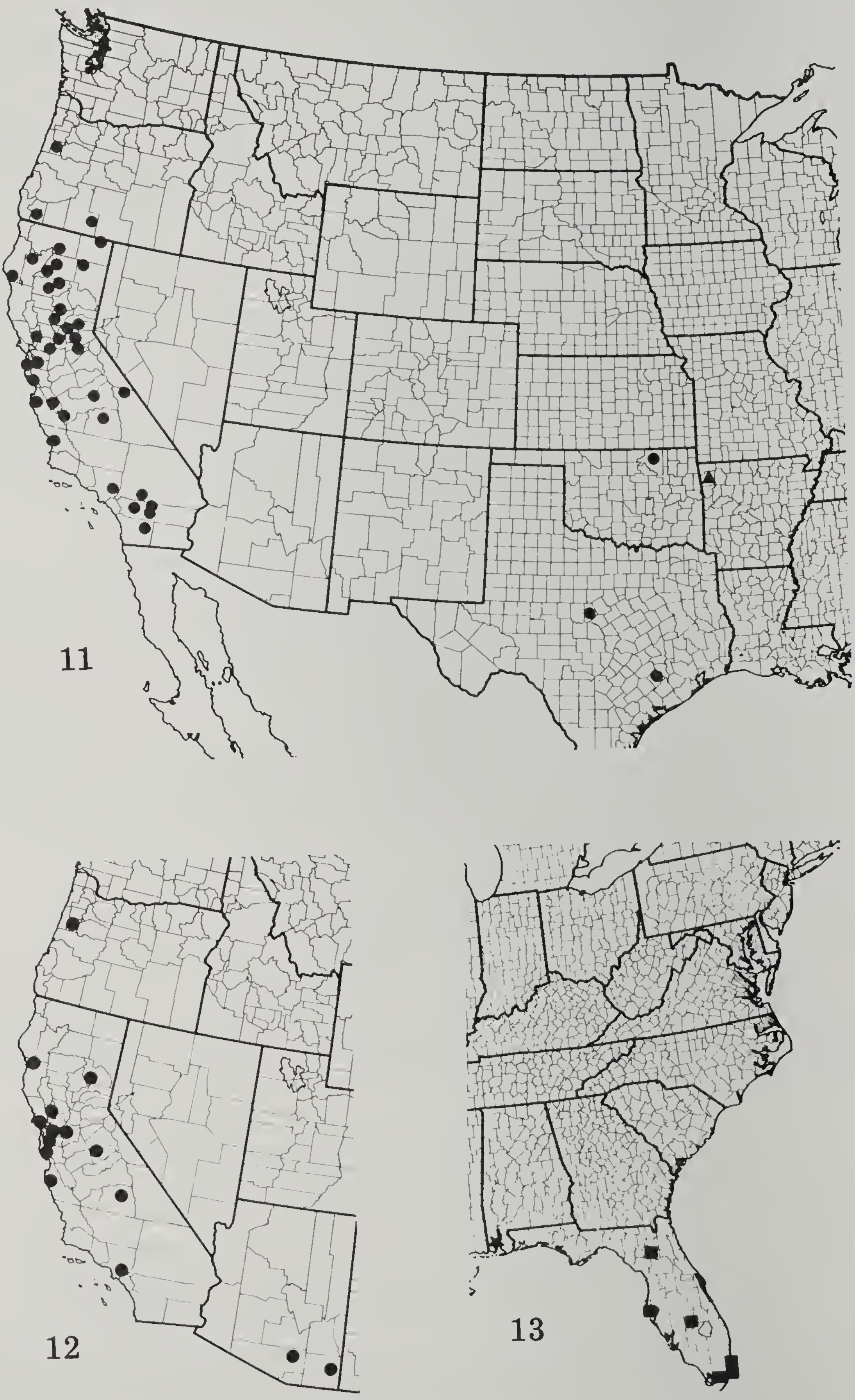

Fig. 11-13. Known geographic distributions of *Metophthalmus* spp.: 11) *M. trux* (dot) and *M. sandersoni* (triangle); 12) *M. septemstriatus*; 13) *M. americana* (star = type locality).

nally; femora only moderately expanded, subcylindrical. Mesosternum with deep pit anteriorly between coxae; metasternum with arcuate pit posteriorly, but anterior to coxae. Genitalia distinctly sclerotized and arcuate in form.

TYPE: Ojai, Cal. 3.10.92; M.C.Z. Type 24495. Head and pronotum missing. Three undesignated specimens with same date compare exactly with remainder of type specimen and Fall's description.

PARATYPE: Single specimen in USNM labeled, (1) Los Angeles Co., Cal., (2) A. Koebele collector, (3) H. C. Fall det., (4) Cotype. Type No. 4434 USNM.

Material examined: Fresno Co.: 15.8 mi. W. Coalinga, 16-XI-71, F. G. Andrews, oak duff [CDAE] (7); 20.9 mi. W. Coalinga, 16-XI-71, F. G. Andrews, *Neotoma* nest and oak duff [CDAE] (2). Kern Co.: 11.2 mi. N., 3.6 mi. E. Bakersfield, 27-XII-65, J. P. Bruen [CISC] (5). Inyo Co.: N. Fork Oak Creek, IX-72, D. Giuliani, black oak duff, 6000′ [CDAE] (1); Panamint Valley, IV-61, A. Koebele [CASC] (4); White Mts., 28-VII-65, O. Clarke, *Populus trichocarpa* duff [UCRC] (13). Los Angeles Co.: Azusa, II-06, A. Fenyes [CASC] (1); Brown's Flats, San Gabriel Mts., 1-II-59 and 2-I-60, M. Knox and E. L. Sleeper [LBSC] (3); Pasadena, VI, A. Fenyes [CASC]; county record only, Coquillet [USNM] (1), A. Koebele [USNM and CASC] (1 each). Monterey Co.: Cachagua Rd., 4 mi. S.E. Carmel Valley, 3-III-72, F. G. Andrews and K. S. Corwin [CDAE] (14); Hastings Res., Tassajara, 25-I-46 and 10-IV-46, Linsdale, *Neotoma* nest [CASC] (6); Jamesburg, 25-I-46, 14-II-46, 16-III-46, IV-10-46 and 9-XII-46, LPT, *Neotoma* nest [CASC] (8); 1 mi. N. Jamesburg, 31-II-72, F. G. Andrews and K. S. Corwin, oak duff [CDAE] (37); Tassajara Rd., 14 mi. S. Hastings Res. Hqtrs., 27-VIII-68, P. Rubtzoff, wood rat nest, 4000′ [CASC] (3). Orange Co.: county record only, 12-II-30, *Neotoma* nest [USNM] (1). Riverside Co.: 14 mi. S.E. Mountain Center, 1-IV-69, F. G. Andrews, oak-pine duff [CDAE] (19); Pinyon Wells, 15-IV-65, 30-X-65, 19-II-66, 14-V-66, 7-I-67, and 4-II-67, E. L. Sleeper and S. L. Jenkins [LBSC] (6); Prado Dam, 4-V-63, I. M. Newell, oak duff [UCRC] (7); Quail Guzzler, Joshua Tree N.M., 14-V-66, E. L. Sleeper and S. L. Jenkins [LBSC] (1); 10 mi. E. Redlands, 3-X-65, R. Ryckman, *Neotoma* nest [UCRC] (24). San Diego Co.: Borrego, Palm Canyon, 25-IV-55, R. O. Schuster [CISC] (9); Borrego, Sheep Canyon, 27-IV-55, R. O. Schuster [CISC] (2); Cuyumaca State Park, 21-V-71 [CDAE] (1). Santa Barbara Co.: Santa Cruz Island, Canyon del Medio, 4-V-68, R. W. Rust, *Petrochelidon pyrrhonota* nest [UCDC] (18). Siskiyou Co.: 3 mi. N. Weed, 23-XI-71, T. R. Haig, oak duff [CDAE] (1).

Remarks: This species is easily separable from the 8-striate species *M. haigi* but is difficult to separate from the 8-striate and morphologically close *M. kanei*. The absence of median carinae on the posterior ½ of the head and the reduction of the pronotal cup to 2 anterolateral nodes distinguish it from *M. haigi*, which has complete median carina and pronotal cup. Differences from *M. kanei* are discussed under that species.

Intraspecific variation in this species is large and difficult to characterize as the differences are always of a degree and, unlike other species, occasionally intrapopulational.

In *M. kanei*, the pronotum is uniformly broadly arcuate (fig. 9) as opposed to the less arcuate more parallel-sided pronotum of *M. rudis*, however the exact form of the pronotum in *M. rudis* is quite variable. Samples from Bakersfield (south) tend to be slightly more parallel-sided and larger; Castroville (north) specimens are also large but the sides are more arcuate; and samples from Jamesburg and Redlands are smaller and more evenly arcuate, but differ from one another in the serrations of the margins.

The numbers of punctures in elytral striae 7+8 are extremely variable within some populations. In most populations the puncture number varies

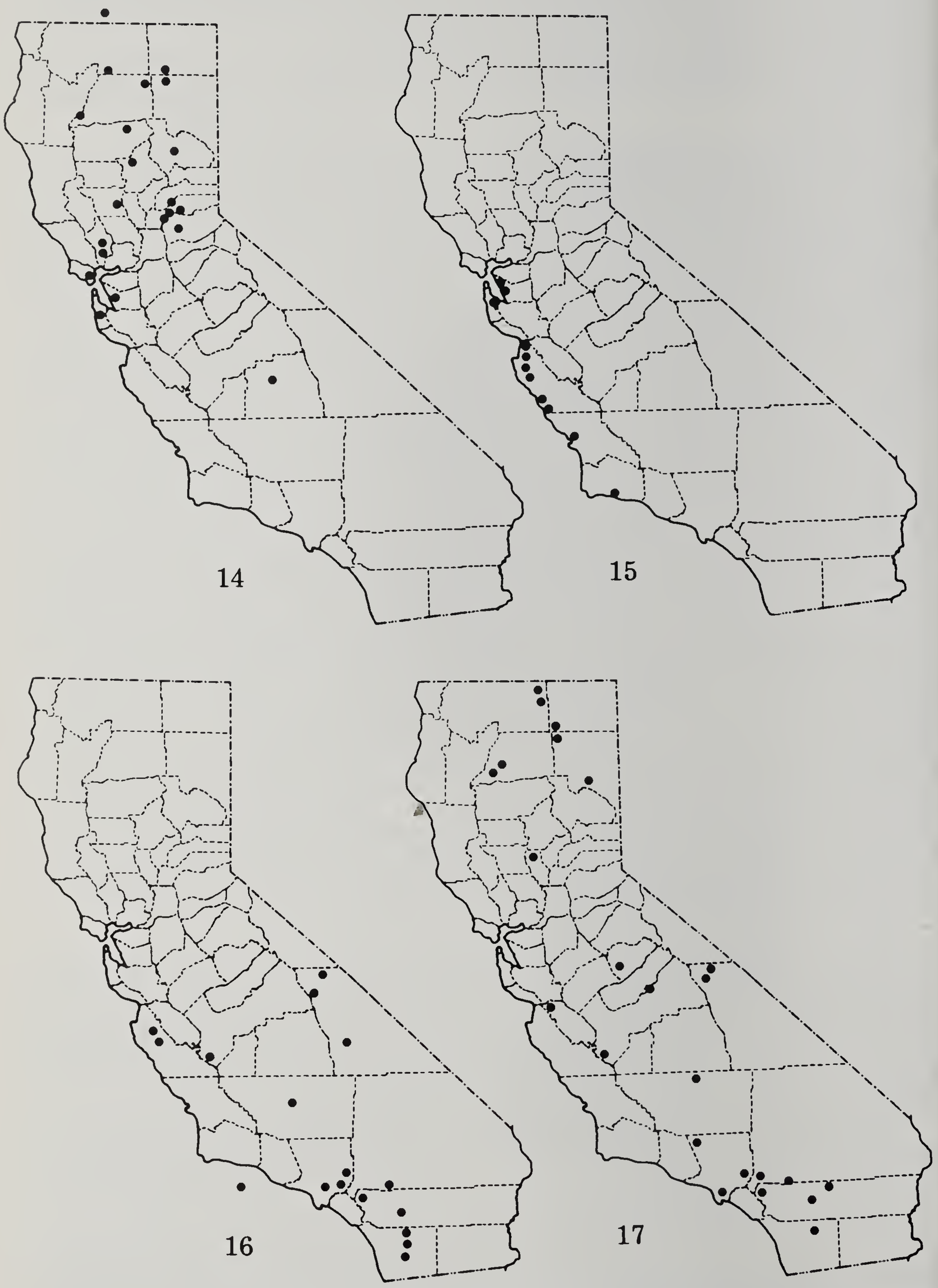

Fig. 14-17. Known geographic distributions of *Metophthalmus* spp.: 14) *M. parviceps*; 15) *M. rudis*; 16) *M. kanei*; 17) *M. haigi*.

between 6 and 8; in specimens from Jamesburg the number varies between 5 and 12, and in specimens from Palm Canyon the punctures are reduced to 1 or 2.

Metophthalmus sandersoni Andrews, **new species**

Description: Length, 1.1 mm. Width, 0.4 mm. Body short; subparallel; humped in profile; glabrous. Cuticle shining, pale reddish brown. White chalky exudate lightly covering dorsum of head, heavily covering low-profile areas of pronotum, lateral margins of elytra almost to apex, and undersurface of body except legs and terminal abdominal segments. Head short; lateral carinae distinct and parallel; median carinae partially effaced in anterior ⅓. Genal flange produced beyond eyes and subparallel; microserrulate. Antennae 11-segmented; short; segments 3-8 transverse. Pronotum wider than long by ratio of 7:5; sides microserrulate, slightly angulate medially (fig. 10); pronotal cup effaced except for lateral margins; collar binodal. Elytra 6-striate; sutural striae 15-punctate, punctations small and uniform in size; interspaces 3 and 5 distinctly carinate; humeral flange moderately expanded and produced basally. Coxae rounded; trochanters moderately elongate and diagonally truncate with femora; femora ellipsoidally expanded. Male genitalia elongate, tapelike.

TYPE: Washington Co., Arkansas, II-20-1938, under bark on log, M. W. Sanderson. Type to be deposited in California Academy of Sciences.

PARATYPES: Same label data as type (3), 1 to Illinois Natural History Survey and 2 (1 pointed and 1 slide-mounted) to remain in author's collection.

Remarks: This species appears to be geographically separated from all other species, however it is close to *M. trux* and considering the wide known distribution of *M. trux* it is possible that additional collecting will show them sympatric (fig. 11). Morphologically it is closest to *M. trux,* from which it can be separated by having the median carinae on the head incomplete.

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THE OCCURRENCE OF THREE SPECIES OF AQUATIC COLEOPTERA ON GRAND CAYMAN ISLAND

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Although distribution records for aquatic beetles of Cuba and the West Indies have been published (Leng and Mutchler 1914, 1917; Young 1953), very few records for species of the Cayman Islands are available. During a one-week visit to East End Village, Grand Cayman Island in the spring of 1975, we collected 3 species of aquatic beetles at outdoor lights. A female *Megadytes giganteus* Laporte was found beneath a floodlight the morning of 2-IV-75. That afternoon there was a brief rainstorm, and at night *Megadytes fraternus* Sharp and *Hydrophilus insularis* Laporte came in large numbers to streetlights. On the following days the weather was clear, and only a few *M. fraternus* and *H. insularis* came to light. We were not equipped to sample ponds to find the source of these beetles, but a brackish pond between East End Village and Bodden Town is a likely habitat. Specimens were identified by Dr. Paul Spangler, Smithsonian Institution, and are in the collection of the senior author.

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MATING BEHAVIOR OF WATER PENNY BEETLES (COLEOPTERA: PSEPHENIDAE): A HYPOTHESIS

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ABSTRACT

Water penny beetles exhibit a "play" behavior on wave splashed rocks in stream riffles, here interpreted as part of the mating behavior. Copulation has been observed 3 times in the laboratory and only twice in the field despite numerous observations over several years. The only explanation of this apparent lack of mating consistent with all the data is that females are at the mating site for such a short time that the act goes unnoticed.

Adult water penny beetles of the genus *Psephenus* perform a strange ritual on wave splashed rocks in riffle habitats. Hubbard (1880) called it a "play" behavior which is probably as good a description as possible. West (1929) interpreted it as a form of courtship and gave a detailed, lively description of what he saw. Since that paper is virtually impossible to find in libraries, it seems worthwhile to reproduce it here.

> "An individual, presumably a female, will pause for moment, after running frantically over the surface of the rock, and rest, with head toward the water, the mouth parts sometimes touching the surface. This attitude of itself may have nought to do with mating, but it is frequently at such a time, that a second individual presumably the male, runs up to the first, apparently in a very excited mood, and explores the posterior end of the first, with antennae and palps. The first invariably whirls about, and sometimes, if the second pauses long enough, returns the salutation by exploring, in the same manner the pygidium of the male. The next step is a dizzy chasing back and forth of the two, which usually terminates in a tangled embrace of antennae, palpi, and legs, the ventral surfaces being approximated. Such a position of course, leaves them nothing with which to cling to the slippery surface, and the most usual result is for the pair to roll off the rock, though they sometimes separate without doing so. If they do fall to the water they release the embrace the instant they strike the surface, and fly to the same, or a new stone where the performance may be repeated several times. Action is so rapid throughout these maneuvers that I am unable to say whether copulation actually occurs, but much careful observation has failed to disclose anything more like mating than the procedure described above. After four or five repetitions of this performance, they will usually rest, sitting sluggishly, a few inches apart."

West was a good observer, and his conclusions are reasonable, though incorrect. The behavior pattern is essentially as follows. When active, the beetles run back and forth horizontally on the wet or moist surfaces of rocks projecting from the stream in turbulent areas. The running is best described as scurrying, and "excited" is a good anthropomorphic term that fits this behavior. The beetles often appear to chase each other and then whirl about, suddenly running off in opposite directions. Two or more beetles may "deliberately" bump each other even when there is ample room to pass and may become entangled for a second or so. They separate and usually go off in separate directions. The running speed is about 4-7 cm per second in *P. falli* (Murvosh, unpublished data). This play behavior is repeated over and over. At irregular intervals the beetles stop running, often all at once, and stand motionless at the water's edge usually with the head facing the water. Murvosh (1971) reported 50 adults of *P. herricki* lined up like this on a single boulder. It is more usual to see just a few beetles per rock. What is interesting is the precise synchrony with which the beetles simultaneously start or stop running when there are several on a rock.

The chase, play, and rest pattern is usually performed about midmorning to midafternoon. Prior to and after that the beetles remain pretty much motionless on the rock somewhere near the water line. The pattern described seems quite stereotyped for *P. herricki, P. texanus, P. falli,* and 2 species from central Arizona. There may be subtle species differences such as found for *P. falli* (Murvosh, unpublished data); these do not become entangled but tend to bump each other slightly, then run off. Brown and Murvosh (1974) described a new species of water penny, *P. montanus,* from the White Mountains of Arizona; it has not been observed to exhibit any of the described phenomena, and is restricted to shore areas rather than turbulent microhabitats (Murvosh and Brown, unpublished data).

We assume that the chase and play activity is part of the mating process, but actual copulation is rare or rarely seen. West apparently never witnessed copulation and we seem to be the only ones who have. Murvosh saw it twice with *P. herricki* in the field and Brown has seen it 3 times in the laboratory—twice with *P. herricki* and once with *P. arizonensis.* Paul Spangler (pers. comm.) who has also studied them has not observed copulation.

The behavior of these beetles has been watched rather intently at varying intervals during the past 15 years, so this apparent lack of mating requires some explanations. We have reviewed the information that bears on this problem and attempted to synthesize a hypothesis consistent with these data.

Parthenogenesis was temporarily suspected but a couple of unmated females, taken from pupae, laid eggs which did not hatch in the laboratory. Aerial mating cannot be completely discredited but field observations suggest this is doubtful. H. H. Ross (pers. comm.) once suggested the possibility that mating might occur at some critical time such as at dusk or dawn. Observations since then suggest otherwise. The quieting down of the beetles and their inactive state seem to preclude nocturnal mating. Nocturnal observations thus far have been negative.

More significant in a positive way are these facts. Observed copulation has been on the rocks where activity occurs. Adults respond positively to water or moist wet surfaces and are almost never found on shore or in dry areas during the heat of the day. The time of observed copulation is short: from a few seconds to about a minute. Females oviposit on the undersurfaces of stones where the play activity occurs or on adjacent rocks and die afterwards without coming to the surface. With few exceptions, the beetles running about the rock are all males, not a mixture of males and females, and this single fact seems to account for the lack of mating. We suggest the following hypothesis to explain what actually happens. A female emerges from the pupal stage beneath a rock at the moist shore area and flies to a wave splashed riffle rock precisely where males are likely to be congregated. She is receptive to a male and copulates immediately, the process requiring less than a minute. After mating she promptly crawls down the edge of the rock, enters the water, and remains there to oviposit and die. The whole act goes unnoticed since females are at the mating site for such a short period of time.

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QUEDIUS TRANSPARENS MOTSCH., A VALID SPECIES (COLEOPTERA: STAPHYLINIDAE)

(102ND CONTRIBUTION TO THE KNOWLEDGE OF STAPHYLINIDAE)

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Abstract

The type material of *Quedius transparens* Motschulsky 1845, deposited at the Museum of Zoology, Moscow State University, Moscow, U.S.S.R., has been studied and a lectotype designated. *Quedius marginalis* Mäklin 1852 and *Q. pugetensis* Hatch 1957 are junior synonyms of this species.

Quedius transparens was described by Motschulsky (1845:358) from specimens from California. It has not been mentioned in the literature since then, except in catalogues, and was considered a *species dubia* more recently. In his catalogue, LeConte (1863:23) correctly placed the species in front of *Q. bardus* Melsh. (synonym of *Q. capucinus* Grav.), but Henshaw (1885:33) catalogued the species as a possible synonym of *Q. molochinus* Grav. In Leng's (1920:110) catalogue, it was assigned, for no apparent reason, to the subgenus *Anastictodera* Csy. (synonym of *Microsaurus* Steph.), and this concept was later accepted by Scheerpeltz (1933:1463). I was not able to examine type material of *Q. transparens* when working on my monograph of North American Quediini (Smetana 1971), and the species is not mentioned in my paper.

Recently, through the kindness of Dr. S. I. Keleynikova, I was able to study the original 2 Motschulsky specimens which are deposited in the Motschulsky Collection, Museum of Zoology, Moscow State University, Moscow, U.S.S.R. These specimens are both pinned and labelled in the same way: "Calif."/"Quedius transparens Motch. Californie"/red rectangular label. The labels are handwritten (apparently Motschulsky's handwriting, see Horn & Kahle, 1935-1937, pl. XVI, Fig. 23, pl. XXI, Fig. 33) on green paper. The first specimen is a male of the subgenus *Distichalius* Csy. identical with the species known at present as *Q. marginalis* Mäklin 1852 (the left antenna, right elytron, and both hind legs are missing). The second specimen is a male of the subgenus *Microsaurus* Steph. identical with *Q. limbifer* Horn 1878 (the abdomen, glued on a separate plate as received, was dissected and the aedoeagus mounted). From Motschulsky's statement in the original description (1845:358), "trois ou quatre points imprimés de chaque côté près du bord des yeux", it is obvious that the species he was describing had additional punctures between the anterior frontal punctures. Only the first specimen has this character, and it therefore is hereby designated as the lectotype of *transparens*; the label "Lectotype Quedius transparens Motsch., A. Smetana des. 1975" has been attached to this specimen. My determination label "Quedius limbifer Horn Smetana det. 1975" has been attached to the second specimen.

Resulting synonymy is as follows:

Quedius (Distichalius) transparens Motschulsky, 1845
    Quedius marginalis Mäklin, 1852, **new synonymy**
    Quedius pugetensis Hatch, 1957, **new synonymy**

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AZTECARPALUS BALL: NEW SPECIES FROM OAXACA, MEXICO, RE-CLASSIFICATION, AND A RECONSTRUCTED PHYLOGENY OF THE *HEBESCENS* GROUP (COLEOPTERA: CARABIDAE: HARPALINI)

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Abstract

Described as new from the Mexican state of Oaxaca are *Aztecarpalus hemingi* (type locality 0.8 kil. e. jcts. Rtes. 190 and 125, 2529 m) and *A. whiteheadi* (=*A. liolus* Ball, 1970, not Bates, 1882, type locality Rte. 175, 27.2 kil. s. Valle Nacional, 1097 m). Re-described is *Aztecarpalus liolus* Bates. Keys are provided to distinguish these species from other members of *Aztecarpalus*. A re-classification of the species is presented, based on phylogenetic considerations, and the new species are incorporated as follows: *schaefferi* group- *A. schaefferi* Ball, *A. marmoreus* Ball; *platyderus* group- *A. platyderus* Bates; *hebescens* group- *A. trochotrichis* Ball, *A. hebescens* Bates, and *A. hemingi,* new species; and *liolus* group- *A. lectocolus* Ball, *A. liolus* Bates, and *A. whiteheadi,* new species. A reconstruction of the phylogeny of the *hebescens* group proposes that differentiation of the species was the result of dispersal between, and isolation and differentiation in, various mountain systems in Oaxaca.

Introduction

The purpose of this paper is to correct a misidentification based on misunderstanding of the type of *Aztecarpalus liolus* Bates (Ball, 1970: 116), and to propose another species name, as required. I also take this opportunity to describe another species, revise the classification of the genus, and present an hypothesis about the phylogeny of the *Aztecarpalus hebescens* group.

My initial essay on this genus (Ball, 1970) was based mainly on Oaxacan material collected in the eastern part of the Sierra Madre de Oaxaca, the western part of the Mije Highlands, and the Pacific coastal part of the Sierra Madre del Sur, collectively referred to below as the "central area". In 1972 and 1974, I re-visited portions of these areas and collected representatives of some of the species previously described. In 1972, I also visited the eastern part of the Mije Highlands (specifically Cerro Zempoaltepetl (or Zempoaltepec)), the Mixteca Alta, and the adjacent north-central part of the Sierra Madre del Sur (specifically Cerro Yucuyacua). In 1974, I again visited the central areas and the Mixteca Alta (See Fig. 8). In each of the peripheral areas were found species not known from the central area. Although none of these species are represented by more than a few specimens, a pattern seems to emerge, explainable in terms of recurrent cycles of the following elements: dispersal of stocks across lowlands, followed by isolation in separate mountain areas with consequent differentiation, and then re-dispersal. Of course, this is the expected pattern of the events for brachypterous montane species, but by working out the details explicitly it is possible to bring this small harpaline genus into the mainstream of biology. Unfortunately, not enough information is available to permit a detailed review of evolution for all species groups.

Material and Methods

Material: The descriptive part of this study is based on 9 specimens collected in 1972 and 1974 and on re-examination of the types of *Aztecarpalus liolus* and of specimens previously assigned to this species (Ball, 1970: 116). The section on phylogeny is based on consideration of this new material, an additional 16 specimens of *A. hebescens* and *A. lectocolus* collected in 1972 and 1974, and on data from the previous study.

Methods: These are the same as described previously (Ball, 1970: 98-100). Ratios and terms are the same, except that the expression "standardized body length" is substituted for "total length". Microsculpture was examined at a magnification of 50X, so the statement "microsculpture effaced" must be understood in this context.

To aid in identification of the new species, a revised key is provided.

Key to Species of *Aztecarpalus*, Based on External Characteristics

1. Tarsal articles with setae on dorsal surfaces .... 2.
1′. Tarsal articles with dorsal surfaces glabrous .... 4.

2(1). Pronotum with postero-lateral angles rounded; elytral microsculpture with lines well developed, meshes transverse .... *A. lectocolus* Ball.
2′. Pronotum with hind angles rectangular; elytral microsculpture various .... 3.

3(2′). Pronotum with sinuation of sides prominent (Ball, 1970: 105, Fig. 10); elytra with lines of microsculpture effaced .... *A. whiteheadi*, new species.
3′. Pronotum with sinuation of sides short and slight (Fig. 2); elytra of males with lines of microsculpture effaced or faint, of females with lines well developed and meshes transverse .... *A. liolus* Bates.

4(1′). Elytra metallic blue or green, interval 3 of at least one elytron with setigerous puncture on disc .... 5.
4′. Elytra black .... 6.

5(4). Elytra metallic green; metepisternum wider than long; hind wings absent .... *A. trochotrichis* Ball.
5′. Elytra metallic blue; metepisternum longer than wide; hind wings fully developed .... *A. schaefferi* Ball.

6(4′). Elytron with scutellar stria long .... *A. marmoreus* Ball.
6′. Elytron with scutellar stria obsolete .... 7.

7(6′). Dorsal surface of elytron faintly iridescent: microsculpture lines of female very fine, close together, meshes few; of male, lines generally effaced. Male front femur with prominent preapical postero-ventral projection (Fig. 3) .... *A. hemingi*, new species.

7′. Dorsal surface of elytron not iridescent; microsculpture lines well developed, meshes numerous, generally isodiametric among females, generally transverse among males. Male front femur without projection (Fig. 4) .... 8.

8(7′). Range—mountains of Puebla and Veracruz .... *A. platyderus* Bates.
8′. Range—mountains of Oaxaca (eastern portion of Sierra Madre de Oaxaca, and western part of the Mije Highlands) .... *A. hebescens* Bates.

SPECIES DESCRIPTIONS

Aztecarpalus hemingi Ball, **new species**

COMPARISONS: Males of *A. hemingi* are unique in form of the front femur (Fig. 3). Among the species characterized by a black dorsum, adult *A. hemingi* are distinctive in having very narrow transverse meshes of elytral microsculpture or lines effaced except basally and apically. In form of the median lobe, male *A. hemingi* and *A. hebescens* are virtually identical but differ in size of spines of the internal sac: in *A. hemingi* males, the spines are uniformly short (Figs. 5B and C); in *A. hebescens,* the spines are of 2 sizes (Ball, 1970: 107, Figs. 28a and b).

DESCRIPTION: Standardized body length, males, 7.84-7.96 mm, females, 7.52-8.08 mm.

Color. Dorsum black. Venter and legs, except tarsi, rufo-piceous to piceous; antennae, palpi, and tarsi rufous.

Setae. Middle coxae each with 5-11 setae; middle femora each with 5 or more setae ventro-anteriorly. Elytral interval 3 without setigerous puncture. Anal setae (on sternum VII, last normally exposed sternum), 2-3 in males (probably 2 is normal) and 4 in females.

Microsculpture. Lines fine, more or less effaced in males. Head, meshes isodiametric; pronotum, meshes transverse; elytra, lines transverse generally not coalesced in form of meshes, in males lines effaced except basally and apically.

Luster. Dorsal surface shining, faintly iridescent.

Head. Frontal impressions small, punctiform.

Pronotum. As in Fig. 1. Sides rather strongly rounded, postero-lateral angles obtuse. Postero-lateral impressions linear.

Legs. Anterior tibia with terminal spur broad. Male front tibia gradually narrowed basally, antero-medial surface crenulate, not swollen. Male front tarsus with articles broad (Scape-Tarsal Ratio, 1.50). Scape-Tibial Spur Ratio: male, 1.00; females, 0.89-1.23.

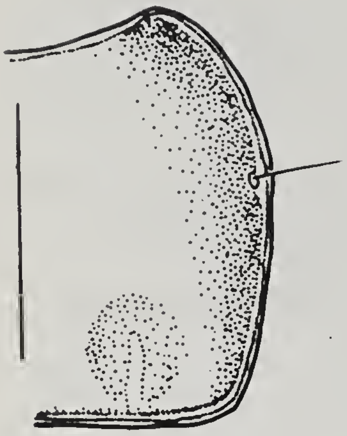
Metepisternum. About 1.50 times wider than long.

Elytra. Humeri angulate, not denticulate. Striae moderately deeply impressed. Scutellar stria obsolete.

Hind wings. Reduced to short stubs.

Male genitalia. Median lobe in ventral aspect sinuate, apical portion curved to left; apical portion slender, long, with denticles in 2 irregular rows (Fig. 5A); apex rounded, with short hook ventrally. Internal sac as in Figs. 5B and C; basal spine dorsad, large; medial area with 5 spines; preapical area with 15 spines.

Female abdomen. Tergum 10 with apical margin rounded.



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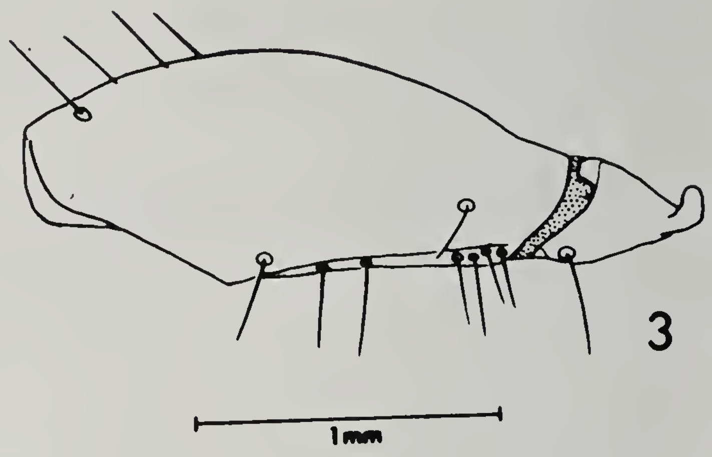

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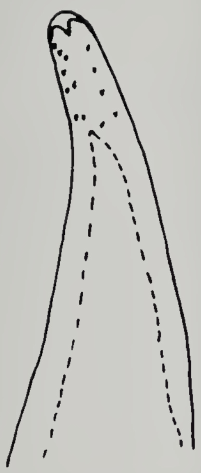
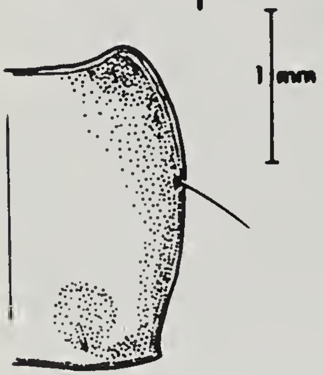


5A



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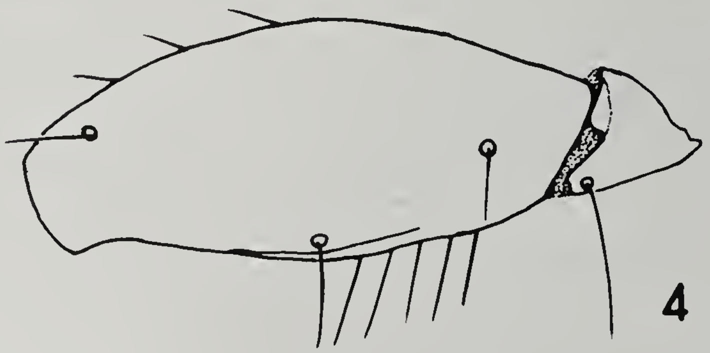

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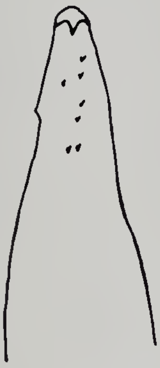
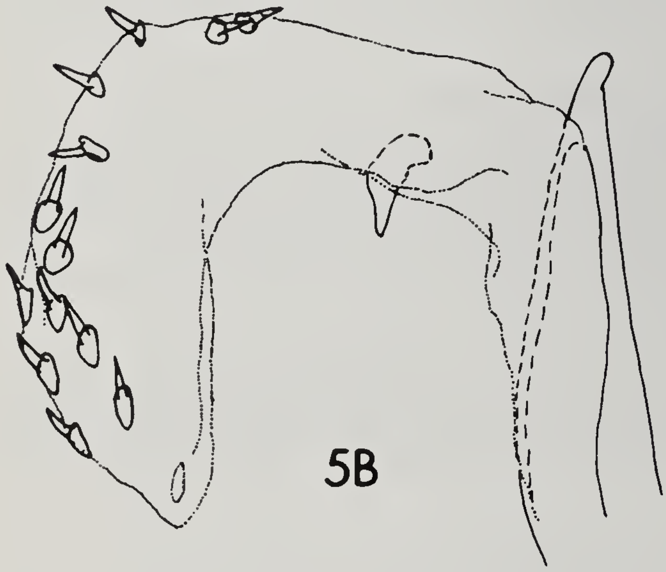
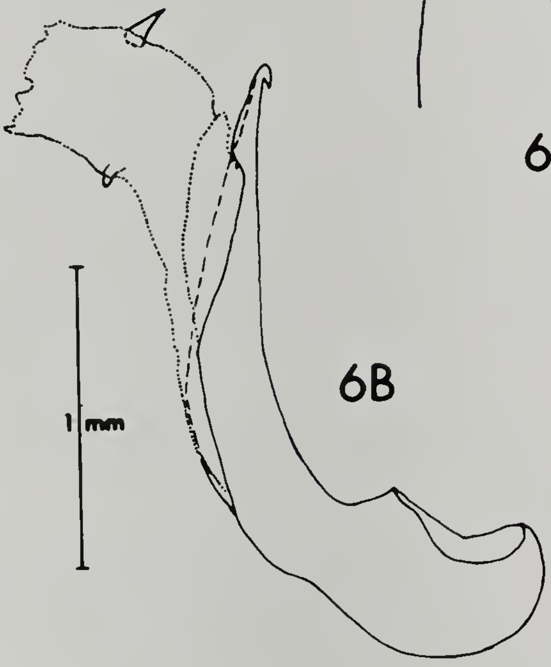


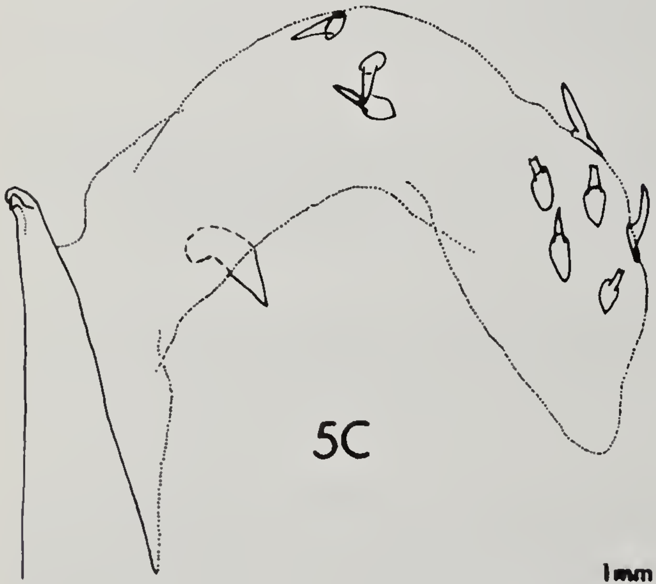
6A



5B



6B



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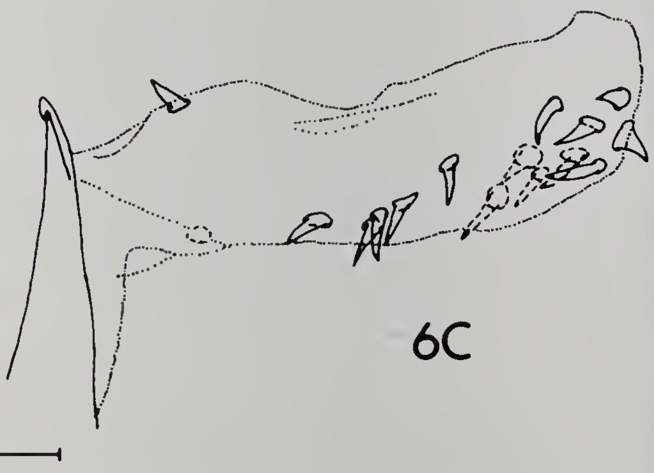

6C

Derivation of specific epithet: Based on the surname of my thysanopterist colleague, Bruce S. Heming, who, in 1972, shared with me the delights of the long walks on the mountain trails of Oaxaca.

Material examined: I have seen 8 specimens of this species. The holotype (male) and allotype (female) are labelled: MEX Oaxaca Microondas Sta. 0.5 mi. e. Jct. Rtes 190 & 125, ca. 2529 m, July 31, 1974; MIDDLE AMER EXP, 1974 D. R. Whitehead, H. Frania & G. E. Ball Collectors. Two female paratypes were collected in the same locality in 1972. One male and 3 female paratypes are labelled: MEX Oaxaca Cerro Yucuyacua, 10300-10900′ (e. Nundaco), August 17, 1972; B. S. Heming, G. E. Ball, collectors. The holotype and allotype are in the United States National Museum. Two paratypes are in the Strickland Museum, University of Alberta. Each of the following institutions has one paratype: British Museum (Natural History); California Academy of Sciences; Museum of Comparative Zoology, Harvard University; and Museum National d'Histoire Naturelle, Paris.

Collecting notes: The specimens were found on the ground, under cover, in or at the edges of rather dry oak forests at high elevations. The 2 localities (Cerro Yucuyacua and the "microondas" (= microwave tower station)), are within 60 kilometers of one another, measured in a straight line. One specimen collected on Cerro Yucuyacua is partially teneral.

Geographical affinities: This species is allopatric to all other known species of *Aztecarpalus* (Fig. 8). It occurs in an isolated section of the Sierra Madre del Sur adjacent to the Mixteca Alta. Southeastward, this area is cut off from high areas by the lowlands of the Rio Verde Basin, specifically the valley of the Rio Cuañana. Northeastward, the area is isolated from the Sierra Madre de Oaxaca and the Mije Highlands by the valley of the Rio Grande.

Relationships: Probably *Aztecarpalus hebescens* is the closest relative of *A. hemingi*. See "Evolutionary considerations", below.

Aztecarpalus liolus Bates

Harpalus liolus Bates 1882: 58. Type material in Oberthür Collection, Box No. 225 (Museum national d'Histoire naturelle, Paris). HOLOTYPE male, labelled: Mexique; A. Deyrolle; Ex Musaeo Chaudoir [red print].

Trichotichnus liolus Csiki 1932: 1220.

Notes on Oberthür material: Ball (1970: 116) mis-identified 3 specimens of another species (*A. whiteheadi,* new species) as members of *A. liolus*. Details are provided below.

Next to the holotype in Box 225 is a female labelled: Mexico Flohr; Harpalus liolus Bates, (female sign).

Comparisons: Adults of *A. liolus* and *A. whiteheadi* are very similar to one another, differing in external characteristics as indicated in the above key. If it were not for differences in form of male genitalia (Fig. 6A and B; cf. Ball,

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Fig. 1-2, Pronotum, right half, dorsal aspect: Fig. 1, *A. hemingi*; Fig. 2, *A. liolus*. Fig. 3-4, Left front trochanter and femur of male, posterior aspect: Fig. 3, *A. hemingi*; Fig. 4, *A. hebescens*. Fig. 5-6, Male genitalia (A, median lobe, apical portion, ventral aspect; B, median lobe, apical portion, and everted internal sac showing spines but not microtrichia, left lateral aspect; C, same, right lateral aspect): Fig. 5, *A. hemingi*; Fig. 6, *A. liolus*.

1970: 106, Figs. 23a and b), I might not consider the 2 forms as specifically different, although the habitat difference would play an important role in inferring systematic relationships (see "Collecting notes" for details).

DESCRIPTION: Standardized body length, males 6.04-7.16 mm., female 6.56 mm.

Color. Body rufo-piceous. Following rufo-testaceous: antennae, maxillae, and labium. Legs generally piceous, tarsi rufo-piceous to piceous.

Setae. Dorsal surfaces of tarsomeres each with few long setae. Middle femur with 5 setae antero-ventrally. Middle coxa with 4-5 setae. Interval 3 of each elytron without setigerous puncture. Anal setae, 2 in male and 4 in female.

Microsculpture. Lines on dorsum very fine, more distinct in female than in males. Meshes on head isodiametric, on pronotum and elytra transverse, very narrow, almost effaced on males.

Luster. Surface shining, elytra of female very faintly iridescent.

Head. Frontal impressions shallow, punctiform, without shallow groove directed toward compound eye.

Pronotum. As in Fig. 2, sides posteriorly briefly sinuate or evenly incurved. Postero-lateral angles rectangular.

Legs. Anterior tibia with terminal spur broadened. Male front tibia with antero-medial surface near base not crenulate, not swollen. Scape-Tarsal Ratio 1.60-1.80. Scape-Tibial spur ratio, males 1.28; female, 1.12.

Metepisternum. About 1.25 times wider than long.

Elytra. Striae moderately impressed; scutellar stria obsolete. Intervals 7 and 8 subcarinate before apex, other intervals flat throughout.

Hind wings. Absent.

Male genitalia. Median lobe in ventral aspect as in Fig. 6A, sinuate on left side; apical portion straight, broader than in *A. whiteheadi* (cf. Ball, 1970: 106, Fig. 23a), moderately long, with few and very small denticles and short apical hook. Internal sac (Figs. 6B and C): basal spine small, not strongly curved; medial area with 6 spines, preapical area with 9 spines.

Female abdomen. Tergum 10 with apical margin rounded.

COLLECTING NOTES: A single male of this species was found on the southwestern slope of Cerro Zempoaltepetl (Fig. 8) at an elevation of 2652 m, in a fallow field that had been cultivated within a year or so. The area had probably supported at one time an oak-pine forest. The carabid fauna was varied, including an assortment of both woodland and meadow-inhabiting taxa. See Ball (1973: 156) for additional details on this area.

DISTRIBUTION: This species is known certainly only from Cerro Zempoaltepetl, Oaxaca.

MATERIAL EXAMINED: I have seen only 3 specimens: 2 in the Oberthür Collection (see above) and a male labelled MEX Oaxaca Cerro Zempoaltepetl 8700-10500′, August 20, 1972; B. S. Heming, G. E. Ball Collectors (University of Alberta, Strickland Museum).

GEOGRAPHICAL AFFINITIES AND RELATIONSHIPS: See these topics under *A. whiteheadi,* below.

Aztecarpalus whiteheadi, new species

Aztecarpalus liolus Ball, 1970: 116 (not Bates, 1882: 58).

Adults of this species most closely resemble those of *A. liolus* but are adequately distinguished in the above key. The most distinctive structural feature is the form of the median lobe: that of *A. whiteheadi* lacks ventral denticulations and the left lateral margin is not markedly sinuate (Ball, 1970: 106, Figs. 23a and b).

I have nothing to add to the previous description of this species, under the name *A. liolus* Bates.

DERIVATION OF SPECIFIC EPITHET: From the surname of Donald R. Whitehead, who collected one of the type specimens, and recognized it at once as a remarkable harpaline.

MATERIAL EXAMINED: HOLOTYPE male, labelled: MEXICO Oaxaca 16.9 mi. s. Valle Nacional 3600′, V.4-5.1966; G. E. Ball, D. R. Whitehead, collectors. A female allotype and male paratype are similarly labelled.

The holotype is in the United States National Museum; the allotype is in the Museum of Comparative Zoology, Harvard University; and the male paratype is in the Strickland Museum, University of Alberta.

GEOGRAPHICAL AFFINITIES: The specimens of this species were collected at a lower elevation than members of any other Oaxacan species, in the Sierra Madre de Oaxaca. Parapatric with this species are *A. hebescens* and *A. trochotrichis,* both of which inhabit the same mountain range but at higher elevations (see Fig. 8). Allopatric with *A. whiteheadi* are *A. liolus* and *A. lectocolus,* also included in the *A. liolus* species group.

RELATIONSHIPS: This species and *A. liolus* are probably sister species, sharing in common an apotypic pronotal form and reduced elytral microsculpture. Of the 2, *A. whiteheadi* seems more apotypic in structural features. The third member of the *liolus* species group, *A. lectocolus,* is the most plesiotypic, with rounded hind postero-lateral angles of the pronotum and well developed dorsal microsculpture. All 3 species are allopatric, and the range of *A. lectocolus* is the most extensive.

EVOLUTIONARY CONSIDERATIONS

Included in this section are a revised classification of the species of *Aztecarpalus* based on a phylogenetic analysis and a detailed phylogenetic treatment of the *A. hebescens* species group.

CLASSIFICATION OF *Aztecarpalus*: The arrangement originally proposed was probably incorrect, the *hebescens* group being based on symplesiotypic character states (elytral microsculpture isodiametric, color of dorsum black) and the shared apotypic similarities of *A. hebescens* and *A. trochotrichis* disregarded, with the latter species placed in a group by itself. I believe now that *A. trochotrichis* and *A. hebescens* belong in the same group. From this group, *A. platyderus* is excluded and placed in a group of its own. I also think that the *schaefferi* group is the sister group of the other taxa of *Aztecarpalus.*

I prefer not to present a detailed phylogenetic treatment at this time, but the general trend of the argument is summarized in the following key to groups. The sequence of groups is believed to be phylogenetic. Each couplet gives plesiotypic and apotypic character states for 1 or 2 characters, the apotypic state indicated by an asterisk. Names of included species are listed in parentheses, following the name of the group.

1. Scutellar stria long; internal sac of male genitalia with basal sclerite*; distribution, Sierra Madre Oriental and northeastern Trans-Volcanic Sierra *schaefferi* group (*A. marmoreus; A. schaefferi*).

1′. Scutellar stria short*; internal sac of male genitalia without basal sclerite; distribution, southeastern Trans-Volcanic Sierra and mountains of Oaxaca .... 2.

2(1′). Internal sac of male genitalia with apical spine*; distribution, southeastern Trans-Volcanic Sierra.......... *platyderus* group (*A. platyderus*).

2′. Internal sac of male genitalia without apical spine; distribution, mountains of Oaxaca* .... 3.

3(2′). Male genitalia, median lobe inclined to left apically*; tarsi with dorsal surfaces glabrous.......... *hebescens* group (*A. trochotrichis; A. hebescens; A. hemingi*).

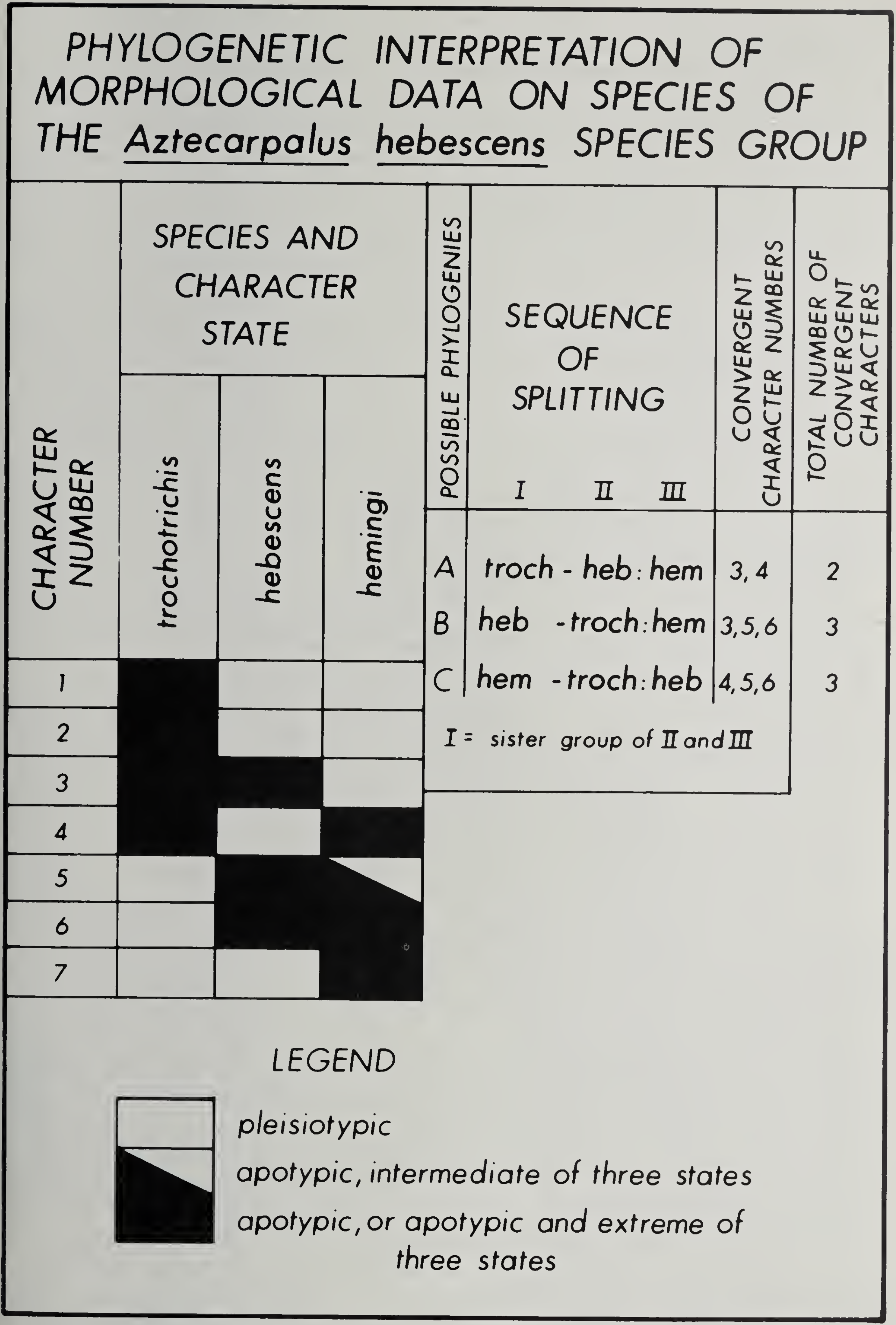
3′. Male genitalia, median lobe straight in ventral aspect; tarsi with dorsal surfaces sparsely setose*.......... *liolus* group (*A. lectocolus; A. liolus; A. whiteheadi*).

TABLE 1. PHYLOGENETIC INTERPRETATION OF CHARACTER STATES OF THE *Aztecarpalus hebescens* SPECIES GROUP.

NUMBER	CHARACTER	INTERPRETATION OF CHARACTER STATE PLESIOTYPIC	APOTYPIC
1	color: dorsum	black	metallic
2	male hind trochanter	bisetose	plurisetose
3	male anal setae	2	4
4	microsculpture: male elytra	meshes clearly indicated	meshes effaced over most of surface
5	male median lobe: apical portion	broad	a. narrower b. narrowest
6	elytron: discal seta	present	absent
7	male front femur	without projection	with projection

Because character distribution is so complex among the known species of *Aztecarpalus* and so much convergence must be accounted for, I am not yet prepared to present an analysis of this topic for the whole genus. However, the phylogenetic pattern for the *hebescens* group seems interpretable, and details are presented below.

PHYLOGENY OF THE *A. hebescens* GROUP: Characters on which this analysis is based are numbered and listed in Table 1, with plesiotypic (ancestral or closest to it) and apotypic (derived) conditions indicated. The sequence provides a maximally dense grouping of apotypic character states for each species (see Fig. 7). Character 4 is 3-state, and the others are 2-state. States of characters 1 to 4, 6, and 7 were classified generally by comparison with a generalized hypothetical member of the subtribe Harpalina: thus, for most



PHYLOGENETIC INTERPRETATION OF MORPHOLOGICAL DATA ON SPECIES OF THE *Aztecarpalus hebescens* SPECIES GROUP

CHARACTER NUMBER	SPECIES AND CHARACTER STATE		
	trochotrichis	*hebescens*	*hemingi*
1	■	□	□
2	■	□	□
3	■	■	□
4	■	□	■
5	□	■	◩
6	□	■	■
7	□	□	■

POSSIBLE PHYLOGENIES	SEQUENCE OF SPLITTING I II III	CONVERGENT CHARACTER NUMBERS	TOTAL NUMBER OF CONVERGENT CHARACTERS
A	troch - heb : hem	3, 4	2
B	heb - troch : hem	3,5,6	3
C	hem - troch : heb	4,5,6	3

I = sister group of II and III

LEGEND

□ pleisiotypic

◩ apotypic, intermediate of three states

■ apotypic, or apotypic and extreme of three states

Fig. 7. Phylogenetic interpretation of morphological data on species of the *Aztecarpalus hebescens* species group.

characters, states listed as plesiotypic are of more frequent occurrence in the Harpalina than are states listed as apotypic. For the median lobe (character 5), the "broad" form is considered as plesiotypic because this seems to be the commonest character state in *Trichotichnus,* the sister group of *Aztecarpalus.* Presumably, therefore, the "broad" form is shared among members of these 2 genera because it was inherited from their common ancestor. Nonetheless, the median lobe of *A. trochotrichis,* though classified as broad and hence as plesiotypic, is probably not identical in details of form to the median lobe of the ancestral stock of the *A. hebescens* group; rather, it is closer to the ancestral condition than to the detailed forms of median lobes of *A. hebescens* and *A. hemingi.* In turn, the detailed form of the median lobe of the *A. hebescens* group ancestral stock was probably like that of *A. platyderus* (Ball 1970: Fig. 21), the condition that I imagine to be most plesiotypic in the genus.

With 3 species, 3 phylogenies are possible (Fig. 7), the most parsimonious being the one of choice—unless there is evidence to the contrary. Phylogeny "A" requires only 2 instances of convergence, whereas "B" and "C" require 3, each. Thus, Phylogeny "A" is accepted, with *A. trochotrichis* as the sister group of the stock that gave rise to the other 2 species. According to this scheme, microsculpture of the elytra has been reduced twice, and male anal setae have increased from 2 to 4, twice.

The distribution pattern provides another clue to understanding phylogeny of the *hebescens* species group. In its simplest terms, *A. trochotrichis* and *A. hebescens* are probably sympatric (they have not been collected in the same locality, but their ranges overlap extensively), both occurring in adjacent portions of the Sierra Madre de Oaxaca (Capulalpam) and in the Mije Highlands. In the more distant Mixteca Alta and central portion of the Sierra Madre del Sur is *A. hemingi.* These 3 species occur at elevations in excess of 2460 m. (Capulalpam is lower, but probably specimens were collected in the surrounding hills, rather than right in town.) The species *A. trochotrichis* may be in wetter areas than the other 2 species, but generally the 3 are in similar places: meadows and rather open oak or pine-oak forests.

Development of the pattern cannot be explained solely in terms of the extant species, nor in terms of their present known ranges. Rather, present discontinuity of range is evidence for past continuity; and, for sister pairs, present continuity is evidence for past discontinuity. To allow potential continuity between isolated ranges of members of this group, climatic conditions would have to be such that the species could live at lower elevations, and hence could enter areas geographically intermediate between the present ranges. Such conditions might also have allowed dispersal of the ancestral stock from further north. (Reasons for believing that *Aztecarpalus* originated further north are given by Ball, 1970: 122). Because most species of the genus are on the eastern slopes of the Mexican mountain systems, it seems reasonable to suggest that initial dispersal took place in this area.

Thus, the following scenario is presented in numbered steps as a recurring cycle of: dispersal; isolation, with consequent differentiation leading to allopatric taxa; and re-dispersal, leading to sympatric or parapatric taxa. The sequence is best followed with reference to Fig. 8. Names for the areas on this map are from West (1964: 63-64). The base map is from "Caminos de Mexico", Map 28 (Anon., 1964).

1. Entry of the ancestral stock of the *hebescens* group into the Sierra Madre de Oaxaca and Mije Highlands, from the Trans-Volcanic Sierra.
2. Isolation therein, and differentiation.

3. Dispersal westward across intervening lower lands into the Mixteca Alta—central Sierra Madre del Sur region. (If the group dispersed southward across or around the central part of the Valley of Oaxaca, no evidence of such movement has been found.)
4. Isolation of stocks in the more eastern Sierra Madre de Oaxaca-Mije Highlands, and in the more western Mixteca Alta-Sierra Madre del Sur ranges.
5. Differentiation, with the eastern refugium isolate giving rise to *A. trochotrichis,* and the western one to the *A. hebescens-A. hemingi* ancestor.
6. Re-dispersal of the latter stock.
7. Isolation of this stock in the western and eastern refugia.

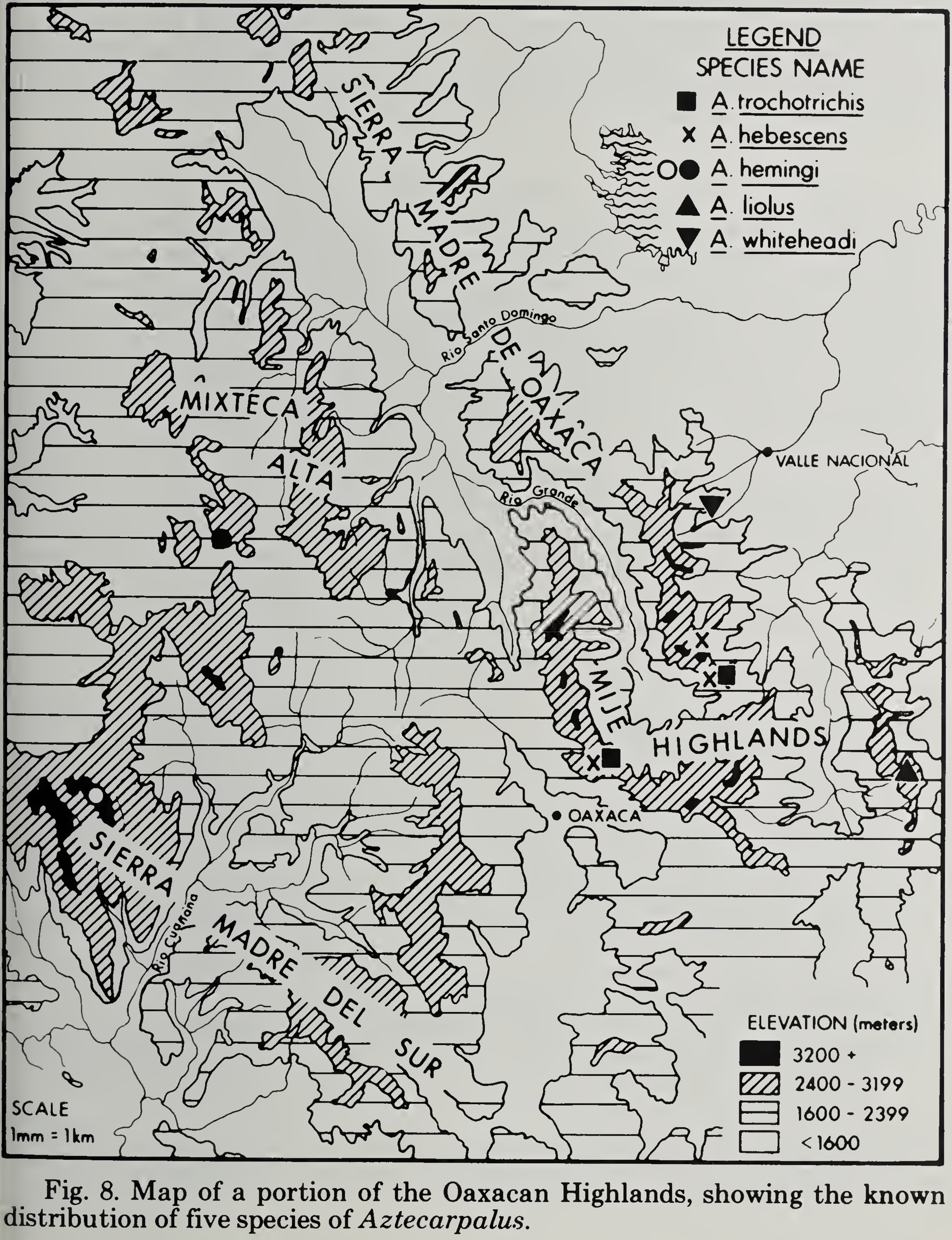


Fig. 8. Map of a portion of the Oaxacan Highlands, showing the known distribution of five species of *Aztecarpalus*.

8. Differentiation, to produce *A. hemingi* in the western refugium and *A. hebescens* in the eastern refugium.

This hypothesis explains the pattern of relationships and distribution as it is presently known. It does not explain why *A. trochotrichis* failed to reach the Mixteca Alta when the *A. hebescens-A. hemingi* stock was able to disperse to the Mije Highlands, nor does it explain why the range of the *hebescens* group is as restricted as it seems to be. The hypothesis does not emphasize the potentially important role that extinction may have played, mainly because of the limited evidence available about this topic.

The hypothesis provides a model for study of other groups of montane species in Oaxaca, comparable to the models for speciation in the Trans-Volcanic Sierra based on *Calathus* (Ball and Nègre 1972), and in the mountains of Guatemala and Chiapas, based on *Cyrtolaus* (Whitehead and Ball 1975). It remains to test these models thoroughly, in terms of additional material of the model groups, in terms of other insect groups, and in terms of implicitly predicted climatic changes and shifts of vegetational zones.

ACKNOWLEDGMENTS

For loan of type material of *Aztecarpalus liolus* Bates, I thank Madame A. Bons and J. Menier, Museum National d'Histoire Naturelle, Paris. My comrades in the field provided cheerful cooperation in obtaining specimens: in 1972, Bruce S. Heming and Peter A. Meyer; in 1974, Donald R. Whitehead and Henry Frania. My colleague Douglas A. Craig read a draft of the manuscript on which this paper is based, and provided useful comments. Illustrative material was prepared by John S. Scott, and the manuscript was typed by Twyla Gibson, both of the Department of Entomology, University of Alberta. I am also grateful to the students in my 1975 advanced taxonomy course, Henry Frania, Kenneth R. Parker, and Douglas H. Smith, for the insight provided on problems in reconstructing the phylogeny of *Aztecarpalus* by their analyses of data and their resulting thoughtful essays. This study was supported partially by NSF Grant GB-3312, and partially by NRC Grant A-1399.

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A SEMIAQUATIC WEEVIL, *PHYTOBIUS CAVIFRONS* (LEC.), MIMICS NYMPHS OF SALDIDAE (COLEOPTERA, CURCULIONIDAE; HEMIPTERA, SALDIDAE)[1]

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ABSTRACT

The weevil *Phytobius cavifrons* (Leconte) was observed behaviorally mimicking nymphs of the saldid, *Saldula pallipes* complex, on a gravel bar in a small river in California. The behavioral mimicry is considered more significant than the relatively superficial morphological similarity. *P. torvipes* (Dietz) = *P. cavifrons* (Leconte), **new synonymy**.

On 6 May 1962, while collecting adult Saldidae for the University of California teaching collection, I accidentally discovered an unusual relationship between the weevil *Phytobius cavifrons* (Leconte) and nymphs of the *Saldula pallipes* complex.

I was on my knees using an aspirator to collect adult saldids which were very numerous. Among them were many black and white checkered nymphs which I was not collecting. By chance, I noticed what appeared to be a pair of nymphs in copulatory position. Since this didn't make sense, I quickly aspirated them and discovered to my surprise that they were weevils in copulo. I then began to observe the "nymphs" more carefully and found that many actually were weevils (I collected 19). Their size, shape, and coloration were similar to those of the nymphs. The distinctive black and white color made both weevils and saldid nymphs very obvious against the sand and gravel background. They were not in any way cryptic.

In addition to morphological similarity was a more important aspect of their mimicry. The weevils moved about on the ground in a quite atypical way, acting like the saldid nymphs. They ran quickly, pausing briefly, only to run again in an erratic manner. Other members of the tribe Phytobiini are usually found on their host plants and do not move in this way, though they do run and fly more quickly than most weevils.

This behavioral mimicry was most important in the success of this model-mimic relationship, since the morphological similarity is relatively slight and not more than can be found between saldid nymphs and numerous other Ceutorhynchinae, most of which are not found in saldid habitats. Such a large change from normal behavior patterns negates the likelihood of similarity due to convergence.

These weevils were collected on a gravel bar extending into Lagunitas Creek at Tocaloma a few miles north of the boundary of Samuel P. Taylor State Park in Marin County. The bar was triangular, about 15 feet long and

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8 to 2 feet wide, with sparse, scattered grass and low herbaceous weeds. I returned a week later to collect more specimens and make more complete observations but found that the gravel bar had been washed away in floods from heavy rainfall during the preceding week.

The saldids were identified by Dr. R. H. Cobben of the Netherlands as part of a widespread complex of forms and races with a holarctic distribution (pers. comm.). *Phytobius cavifrons* is less widespread, being restricted to the western U. S. I have specimens from California, Washington, and Utah of this species, which is highly variable in size and color pattern. The variety *torvipes* Dietz (1896), described as *Pelenomus,* is incorrectly treated as a species by Hatch (1971). Hatch reports that *P. torvipes* "adults are frequently taken on mud banks". I have checked the types and series of specimens from Washington and California and have determined that the name *P. torvipes* is synonymous with *P. cavifrons* (**new synonymy**).

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NORTH AMERICAN THANEROCLERINAE LARVAE (COLEOPTERA: CLERIDAE)

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Abstract

Mature larvae of 3 Thaneroclerinae genera, *Thaneroclerus, Zenodosus* and *Ababa* are described or redescribed and a key for their identification presented. The mature larva of *Ababa tantilla* (LeC.) is described. Characters of potential value for deriving a classification of the subfamily are discussed.

Diagnoses of larval Thaneroclerinae are based on relatively few taxa. The subfamily was characterized by Böving and Champlain (1920) in a work based solely on the larva of *Thaneroclerus buquet* (Lef.). Since that time, larvae of *Zenodosus, Isoclerus* and *Metaxina* have been described or figured.

Recent collections of *Ababa tantilla* (LeC.) by John Lawrence, Museum of Comparative Zoology, Harvard University, complete the larval representation of North American Thaneroclerinae genera. Examination of this material along with specimens of *T. buquet* and *Zenodosus sanguineus* (Say) provided by Dr. D. M. Anderson, National Museum of Natural History, permits a further assessment and clarification of thaneroclerine subfamilial and generic characteristics and allows the introduction of new information including a description of the mature larva of *A. tantilla.*

North American Thaneroclerinae

Description: Mature larva with body subclaviform, clothed with scattered short whitish hairs, segmental surfaces salmon colored, intersegmental membranes light salmon to cream colored, sclerites testaceous to piceous. *Head* capsule subrectangular with dorsal surface slightly convex, sides parallel, ventral surface flattened, longer than wide in dorsal view (4:3) and longer than deep in lateral view (3:2); epicranium smooth or finely wrinkled, epicranial suture distinct; frons elongate, oblique, with anterior margin transverse; hypostoma with anterior margin transverse; stemmata, 5 on either side arranged in anterior row of 3 and posterior row of 2; antenna 3 segmented, basal segment barrel shaped, middle segment glabose, about 2/3 as long as basal segment in dorsal view, its apical surface oblique and bearing a short conical appendix, terminal segment tubular, slightly bowed at middle, equal to middle segment in length, apex bearing a single long hair; mandible about as long as frontal suture, longer than wide in dorsal view (3:2); gula as long as frons, sides abruptly expanded in front of hind margin, expanded area sometimes bearing a large tubercle. *Thorax* much shorter than abdomen in dorsal view; pronotum subrectangular, much wider than long (2:1), bearing a well-chitinized shield equal to head in width, prosternal sclerite elongate and slender; meso- and metanotum each bearing a pair of subcircular sclerites. *Legs* shorter than meso- and metathorax combined (2:3), joints well chitinized. *Abdomen* with segments 1 through 8 about 1/2 as long as broad in dorsal view, ampullae faintly indicated, preeusternal and eusternal sclerites fused, spiracles bicameral and smaller than those of meso- and metathorax (2:3); segment 9 as long as broad in dorsal view, urogomphi rudimentary or lacking, basal plate subcircular, its surface flattened and lightly to heavily scleritized or basal plate absent.

Discussion: Thaneroclerinae is unique among Cleridae in that it is the only subfamily in which the larvae exhibit a definite epicranial suture and the only one with bicameral spiracles, the thoracic members of which are larger than those on the abdomen. The subfamily is further characterized by the elongate, rectangular head bearing 5 stemmata on either side and by the abrupt postmedial expansion of the gula (Fig. 2).

The nature of the gular tubercle and the development of the urogomphi and basal plate provide the character states most useful for separating larvae of the 3 North American genera.

KEY TO MATURE LARVAE OF NORTH AMERICAN THANEROCLERINAE

1. Ninth abdominal tergum bearing a basal plate; gula bearing a large postmedial tubercle 2
1′. Ninth abdominal tergum without a basal plate; gular surface flat .... *Ababa*

2(1). Basal plate bearing paired rudimentary urogomphi .... *Thaneroclerus*
2′. Basal plate without urogomphi .... *Zenodosus*

Ababa Casey (1897:653)

Description: Mature larva—length 4.7-5.0 mm, head capsule width .30-.35 mm; body broadest at abdominal segment 5, surface with membranous areas salmon colored, sclerites testaceous to flavotestaceous. *Head* capsule with surface smooth; stemmata on either side arranged in anterior arcuate row of 3 and posterior row of 2, lower member of posterior row at level below upper member of anterior row (Fig. 1); mandible with outer margin strongly bowed, broadly arcuate inner margin bearing small pointed tooth distal to retinaculum (Fig. 3); gula with lateral margins abruptly expanded in front of hind margin, surface flat or very slightly tumescent behind middle (Fig. 2). *Thorax* shorter than abdomen in dorsal view (1:2); pronotum with dorsal shield moderately sclerotized, covering nearly its entire surface; mesonotum bearing pair of moderately sclerotized, subcircular sclerites; metanotum with paired sclerites faintly indicated. *Abdomen* with tergum 9 membranous, basal plate and urogomphi absent.

Discussion: The preceding description is based on specimens of *A. tantilla*. They are most easily distinguished from mature larvae of *Zenodosus* and *Thaneroclerus* on the basis of size. The absence of a basal plate on abdominal segment 9 and the absence of a gular tubercle serves further to distinguish *Ababa*.

The following description of *A. tantilla* is based on an understanding of characters useful at the specific level in other clerid taxa.

Ababa tantilla (LeC.) (1865:96)

Description: Mature larva—length 4.7-5.0 mm, head capsule width .30-.35 mm. *Head* capsule testaceous, surface smooth, genal and hypostomal areas bearing scattered hairs; frons testaceous with anterior 1/4 evanescent to dark brown anterior margin, surface smooth, bearing long hair near each lateral margin at middle and at anterior 1/4 and bearing 4 short hairs subequally spaced behind anterior margin; clypeus transverse, surface smooth and translucent; labrum transverse, surface smooth and tumescent; mandible with dorsal surface bearing single hair in front of hind margin, inner margin broadly arcuate, bearing small pointed tooth in front of retinaculum (Fig. 3); maxilla with base of cardo and stipes transverse, glabrous; labium appearing membranous and undifferentiated; gula with lateral margins abruptly expanded in front of hind margin, surface smooth, flat and glabrous (Fig. 2). *Abdomen* with tergum 9 membranous, basal plate and urogomphi absent.

Specimens Examined: FLORIDA: Jackson Co., Florida Caverns State Park, 6-IX-68 (3); 5-IV-69 (1).

Thaneroclerus Lef. (1838:13)

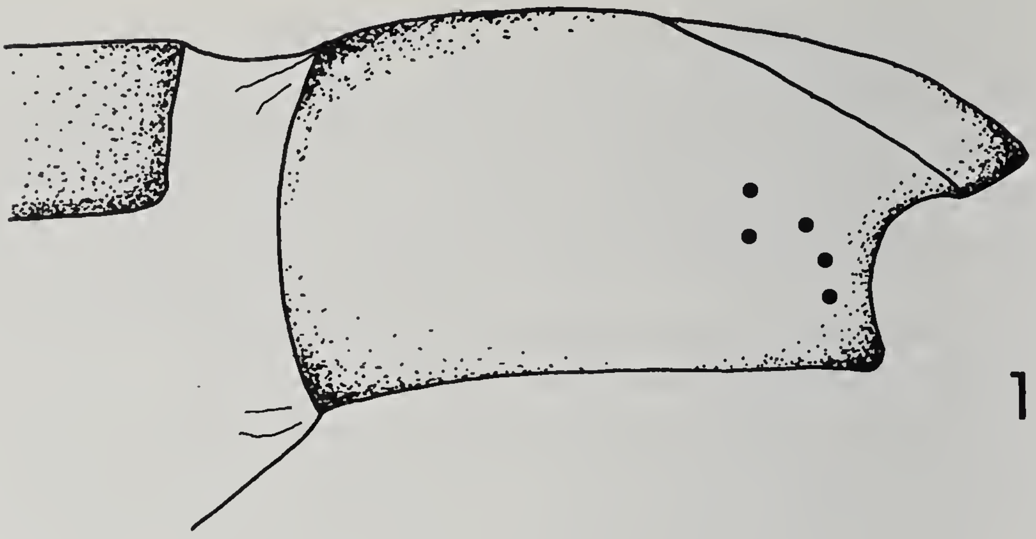
Description: Mature larva—length 11.0 mm, head capsule width 0.9 mm; body with sides subparallel, surface with membranous areas salmon colored, sclerites fuscotestaceous to piceous. *Head* capsule with surface smooth to finely wrinkled; stemmata on either side arranged in vertical anterior row of 3 and posterior row of 2 at an acute angle to anterior row, lower member of posterior row at level above the upper row (Fig. 4); mandible with outer margin convex, inner margin bearing obtusely crowned retinaculum at middle and low obtusely crowned tooth immediately distal to retinaculum; gula with large postmedial tubercle which bears one hair near center on either side. *Thorax* much shorter than abdomen in dorsal view (1:4); pronotum with dorsal shield well sclerotized and covering nearly its entire surface; meso- and metanotum bearing paired, moderately sclerotized, subcircular sclerites. *Abdomen* with tergum 9 bearing well sclerotized, subcircular basal plate; urogomphi reduced to 2 low tumescences arising in front of hind margin on basal plate.

Discussion: The preceding description is based on mature larvae of *T. buquet.* They are recognized most easily by their rudimentary but discernible urogomphi. Earlier instars have relatively larger urogomphi that make them easily distinguishable from both *Ababa* and *Zenodosus.* The larva of *T. buquet* was described and figured by Böving and Champlain (1920).

Specimens Examined: NEW YORK: Albany Co., 15-21-VIII-70 (4).

Zenodosus Wolcott (1910:21)

Description: Mature larva—length 9.2-11.0 mm, head capsule width 0.9-1.0 mm; body with sides subparallel, surface with membranous areas salmon colored, sclerites fuscotestaceous. *Head* capsule with surface smooth; stemmata on either side arranged in vertical anterior row of 3 and posterior row of 2 at an acute angle to anterior row, lower member of posterior row at level above upper member of anterior row; mandible with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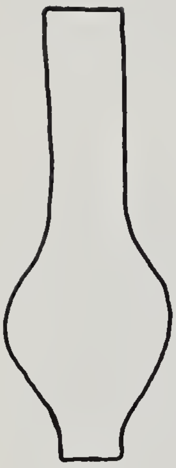
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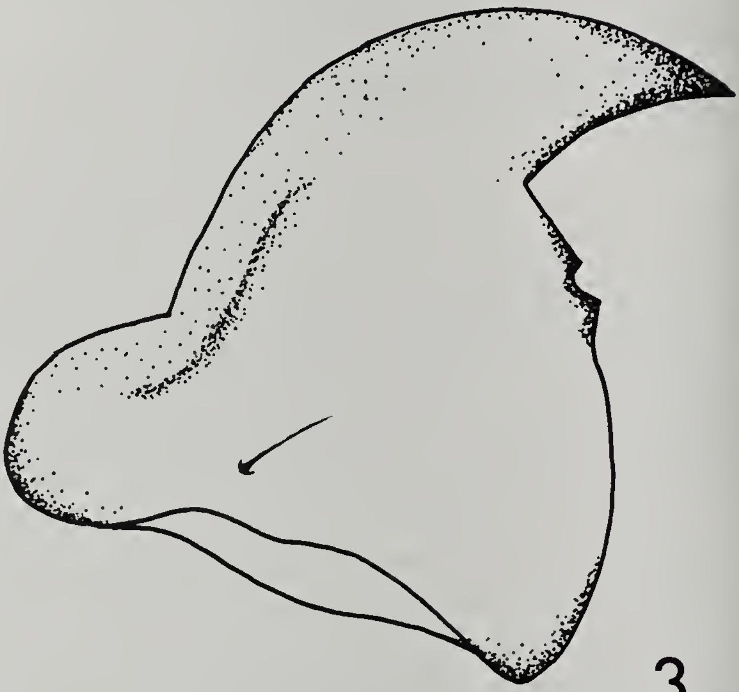
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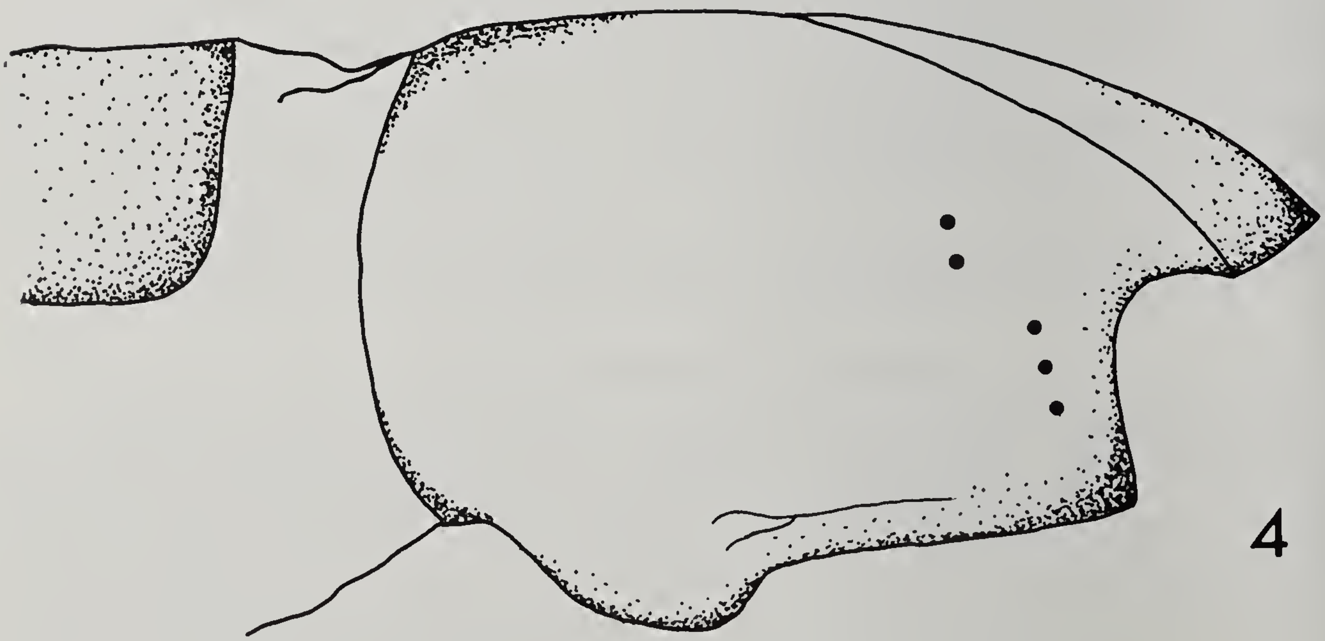
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outer margin convex, inner margin bearing obtusely crowned retinaculum at middle and low obtusely crowned tooth immediately distal to retinaculum; gula with large postmedial tubercle which bears one hair near center on either side. *Thorax* much shorter than abdomen in dorsal view (1:4); pronotum with dorsal shield well sclerotized and covering nearly its entire surface; meso- and metatotum bearing paired moderately sclerotized, subcircular sclerites. *Abdomen* with tergum 9 bearing well sclerotized, subcircular basal plate, urogomphi absent.

Discussion: Larvae of *Zenodosus* can be separated from *Thaneroclerus* most satisfactorily by the absence of urogomphi. Böving and Champlain (1922) described and figured the mature larva of *Z. sanguineus* (Say).

PHYLOGENETIC CONSIDERATIONS

In their monograph, Böving and Champlain (1920) referred to *Thaneroclerus* as a very isolated genus. This contention is substantiated now for the entire North American Thaneroclerinae fauna by the elongate, rectangular head, the presence of a distinct epicranial suture, and modifications of the gula.

The availability of *Ababa* provides an opportunity to analyze character states within the subfamily. Crowson (1964) included the New Zealand species *Metaxina ornata* Broun in Thaneroclerinae and pointed to it as a primitive member of the subfamily on the basis of 3 larval characteristics: the presence of well-developed urogomphi, large notal sclerites, and the absence of a gular tubercle. Crowson's description and figures along with the North American genera treated herein point out several important characters.

Although any serious attempt to erect a classification of Thaneroclerinae would necessitate complete analysis of all available semaphoronts, it is worthwhile to discuss states of several larval characters that comprise transformation series or morphoclines (Table 1). Each character state is represented by a letter: capital letters denote apomorphic states, the lowercase letter in each instance represents the plesiomorphic state. States judged plesiomorphic are those that occur commonly in other clerid subfamilies or Cleroidea families.

The nature of the urogomphi and attached basal plate comprise one such morphocline. The heavily sclerotized basal plate and well-developed urogomphi of *M. ornata* are common among clerid larvae and are regarded as plesiomorphic. The reduction or loss of urogomphi and the loss of the basal plate represent apomorphic states.

Another morphocline involves the postmedial expansion of the gular margins and associated tubercle. The character state common to other clerid subfamilies, a more or less parallel-sided gula with a flat postmedial surface, is considered plesiomorphic. Expanded margins and the development of a tubercle are considered apomorphic.

Two additional morphoclines are comprised of states of the meso- and metanotal sclerites. Crowson (1964) considers the presence of a single large

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Fig. 1-4: 1) *A. tantilla,* head capsule, lateral (scale line = 0.2 mm); 2) *A. tantilla,* gula (scale line = 0.15 mm); 3) *A. tantilla,* left mandible, dorsal (scale line = 0.05 mm); 4) *T. buquet,* head capsule, lateral (scale line = 0.4 mm).

sclerite such as that found on the mesonotum of *M. ornata* to be primitive. Reductions of meso- and metanotal sclerotization are considered apomorphic.

The distribution of character states available for analysis suggests that *Ababa* may occupy a position as the most derived genus among those under consideration and that *Thaneroclerus* and *Zenodosus* are related more closely to one another than to *Ababa*.

TABLE 1. OCCURRENCE OF SELECTED CHARACTER STATES AMONG THANEROCLERINAE LARVAE.

Characteristics	*Metaxina*	*Thaneroclerus*	*Zenodosus*	*Ababa*
1. Basal plate and urogomphi a. basal plate and urogomphi well developed A. basal plate well developed, urogomphi reduced to 2 short paired projectives A′ basal plate well developed, urogomphi absent A″ basal plate and urogomphi absent	a	A	A′	A″
2. Development of gular tubercle b. gula with margins straight and surface flat B. gula with margins expanded and surface flat B′ gula with margins expanded and tubercle present	b	B′	B′	B
3. Sclerotization of mesonotum c. single large plate C. small paired plates	c	C	C	C
4. Sclerotization of metanotum d. small medial plate and paired lateral sclerites D. small paired sclerites D′ paired sclerites rudimentary	d	D	D	D′

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THE LARVAE OF *NEBRIA LACUSTRIS* CASEY AND *NEBRIA PALLIPES* SAY (COLEOPTERA, CARABIDAE)

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Abstract

The larval stages of *Nebria lacustris* may generally be separated from those of *N. pallipes* by differences in nasale proportions. When the nasale character is indistinct, stadium-specific head capsule measurements afford reliable species identification.

Nebria lacustris and *N. pallipes* are abundant predator-scavengers which are sympatric in riparian insect communities of Vermont. Although imagines are well described (Lindroth, 1961), comparatively little study has been devoted to larvae. We can now offer information relating to identification of the 3 larval stadia and species recognition.

Because of great changes in length with each stadium, total length cannot be used to separate the instars. However, we find that head capsule dimensions are reliable aids for stadium separation (Table I). Additional characters may be used in the field to distinguish 1st instars. First stage larvae are equipped with 2 heavily sclerotized egg bursters on the frontal piece (Fig. 1). Also, the urogomphi of 1st instars bear fewer setae (4-6 each) than those of 2nd and 3rd stage larvae (16-26 each) (Fig. 2).

Andersen (1970) suggests that nasalar proportions and shape of the anterior margin of the frontal piece are useful for identifying several European *Nebria*. We have found that similar features may be used to identify

Table I. Head capsule dimensions for separating larvae of *Nebria pallipes* and *Nebria lacustris*.

Dimension	Stadium	*N. pallipes*	*N. lacusris*
frontale width	1	.45 mm or less	.45- .52 mm
	2	.50- .60 mm	.60- .65 mm
	3	.70- .75 mm	.75- .85 mm
head width	1	.80 mm or less	.80- .90 mm
	2	.90-1.00 mm	1.00-1.10 mm
	3	1.20-1.30 mm	1.30-1.40 mm
head length	1	.95 mm or less	.95-1.05 mm
	2	1.10-1.20 mm	1.20-1.30 mm
	3	1.30-1.45 mm	1.45-1.55 mm

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most specimens of riparian *Nebria* larvae collected in Vermont (Fig. 3). Known larvae, reared from laboratory-laid eggs, were used for preliminary morphological investigations. Our studies show that the nasale of *N. pallipes* is longer than that of *N. lacustris.* The 2 median nasalar teeth of *N. pallipes* are at least twice as long as the peripheral teeth. When viewed dorsally the nasale of *N. pallipes* also appears narrower than that of *N. lacustris* because it is more acutely rounded with the median teeth on a higher plane than the peripheral teeth. The nasale of *N. lacustris* is flat or, at most, smoothly rounded in its dorsal aspect.

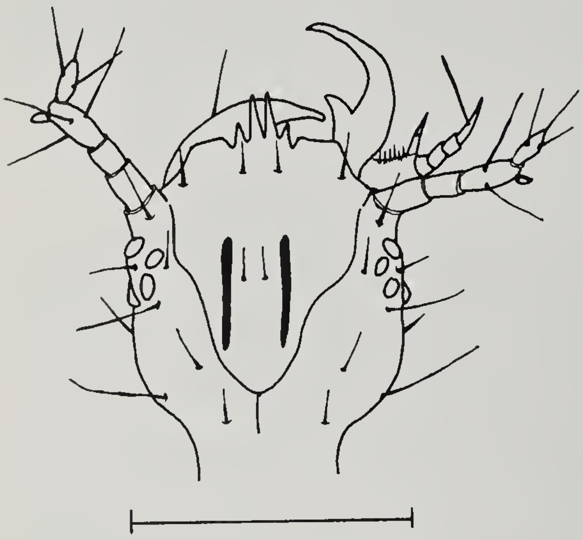

Figure 1

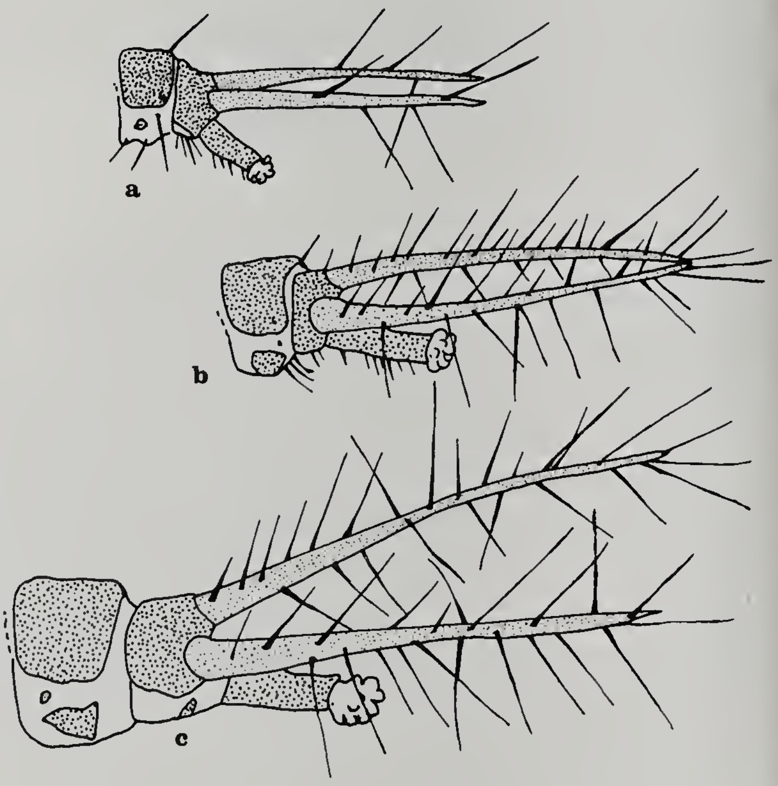

Figure 2

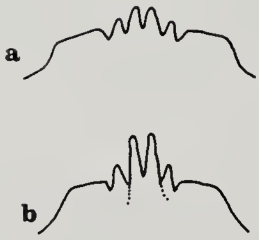

Figure 3

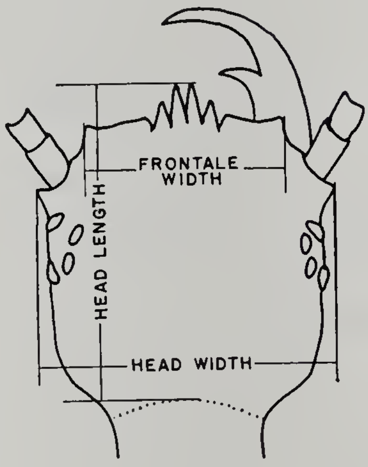

Figure 4

Fig. 1. *Nebria pallipes* Say. First stage larva showing egg bursters.

Fig. 2. *Nebria lacustris* Casey. Urogomphi of (a) 1st stage larva, (b) 2nd stage larva, and (c) 3rd stage larva.

Fig. 3. Front margin of frontale in outline of (a) *Nebria lacustris* and (b) *N. pallipes.*

Fig. 4. Generalized *Nebria* larva head capsule showing dimensions measured for identification.

Although field collected larvae may be generally ordered into 2 groups by use of nasale proportions, a small percentage of intermediate forms (about 5%) are encountered. The possibility of intermediate hybrids seems most unlikely because reproductive isolation mechanisms exist. There are, for example, significant differences in aedeagus morphology (Bell, 1955) and peak breeding times are separated by about 4 weeks in these 2 species (Spence, 1974). In addition, we have never collected intermediate adults despite extensive collecting throughout Vermont.

We have measured 3 head capsule dimensions on laboratory-reared larvae (Fig. 4) and find slight, but consistent species differences (Table I). Relative species dimensions for larvae are not predicted from adult sizes. Although *N. pallipes* is the larger adult form, it is smaller than *N. lacustris* in each larval stage. When the nasale character is intermediate, head capsule measurements afford a method to identify the species after the specimen has been assigned to the appropriate larval stadium. Identification based solely upon head capsule dimensions should be interpreted cautiously in areas where these two species do not co-occur. There is some evidence to suggest that the differences in head size may represent character displacement.

Owing to the reproductive timing differences mentioned above, 1st instar *N. pallipes* co-occur with 2nd instar *N. lacustris* and for analogous reasons 2nd instar *N. pallipes* co-occur with 3rd instar *N. lacustris.* If size difference can be considered as a simple form of structural specialization, as suggested by Hutchinson (1965), the different reproductive timing in these species coupled with the observed differences in head size may aid in reducing interspecific competition (Spence, 1974). The implications of this "strategy" for allowing the broad coexistence of the 2 species will be discussed more fully in a future paper.

We emphasize that *a priori* knowledge of adult distributions is necessary when using this comparative scheme. It is presently unknown how other species of Nearctic *Nebria* may vary with respect to nasalar proportions.

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FOOD-PLANTS OF *ODONTOTA DORSALIS* (THUNBERG) (COLEOPTERA, CHRYSOMELIDAE)

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Food-plants have long been used for descriptive purposes in the phytophagous family Chrysomelidae. In fact, for some groups, the food-plant is of taxonomic importance equal to morphological features (Brown 1945). The food-plant of the hispine chrysomelid *Odontota dorsalis* (Thunberg) is usually considered to be black locust (*Robinia pseudoacacia*). However, Butte (1968) presents a review of the biology of *O. dorsalis,* listing the following as food-plants: black locust; white oak; elm; beech; birch; hawthorn; apple; and soybeans. Thus, *O. dorsalis* is not monophagous.

Eleven specimens of this beetle were collected on rhododendron at the Peaks of Otter, Bedford Co., VA, 18-VII-1975. No evidence of mining was observed, but the number of specimens and the paucity of nearby locust trees lead to the conclusion that this incidence was more than coincidental. This observation is offered to increase our knowledge of the natural history of this beetle. Clearly, more effort toward elucidation of the food plants of *O. dorsalis* and other Hispinae is needed.

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A NEW *MEGASOMA* FROM BAJA CALIFORNIA, MEXICO (COLEOPTERA: SCARABAEIDAE: DYNASTINAE)

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Abstract

Megasoma lenczyi is a new species (type locality: 8 mi. N San Felipe, Baja California, Mexico), the 4th *Megasoma* species reported from Baja California. It is described and figured, and included in a revised key to *Megasoma*.

Recently, September 1973, Dr. Rudolph Lenczy of Green Valley, Arizona, had the good fortune to collect still another unnamed *Megasoma* in Baja California, Mexico. Three other species are known to occur in this same Mexican state, so a fourth species is an unexpected surprise.

In Alan Hardy's key to the species of *Megasoma* of North and Central America (Canadian Entomologist, Vol. 104, May 1972, p. 766), males of the new species key out to *M. thersites* Lec. and *M. vogti* Cartwright but differ in not having a pronotal horn and not having protruding anterior pronotal angles. Females of the new species are very similar to *M. sleeperi* Hardy but in *M. sleeperi* the clypeal teeth are not as broadly based, the median tubercle of the head is binodose, the pronotal punctures are slightly smaller, the posterior angles of the pronotum are subangulate, the fine punctures of the elytra are not as evident or numerous, and the three teeth of the anterior tibiae are more nearly equidistant from each other. In the new species, the two anterior teeth are very distinctly closer together. A modification of Hardy's key is presented following the description below.

Megasoma lenczyi Cartwright, **new species**
Fig. 1

Holotype Male. Length 30 mm, width 16 mm. Dark brown, shining through moderately dense covering of long (about 0.8 mm), appressed gray hair. Clypeus bidentate, teeth erect; very finely scabriculate, slightly arcuate, flattened margin between teeth about equal in length to lateral margin from tooth to posterior angle of ocular canthus; lateral margins of clypeus and ocular canthi cariniformly margined, sides of clypeus subangularly rounded outward, canthi in turn rounded outward at right angles to clypeus and curved backward to eyes. Head with strong, median, bifurcate cephalic horn 2-1/2 mm high, tips of horn recurved and divergent; surface, except for smooth tips of horn, very finely, densely punctate basally posterior to horn, with close, fine hair directed toward horn.

Pronotum without horn, broadly rounded at greatest width (13 mm), anterior angles right angled, not divergent, posterior angles rounded; smooth flat border anteriorly, fine cariniform borders at base and sides; midline length 9 mm with densely hairy, very weakly depressed small area at anterior 1/3, middle 1/3 slightly more convex with small, smooth, shiny, almost impunctate area immediately behind noticeable convexity, followed by shallow, very closely, finely punctate, depressed area or sulcus to base; surface elsewhere with mixed punctures, from very coarse to very fine, often dense or scabriculate, coarse punctures anteriorly and laterally, curving around finely, densely punctured median convexity from anterior angles to base. Decumbent surface hair sparse across anterior surface, denser from just inside anterior angles curving around to middle at base, still denser inside lateral margin into posterior angles, leaving small bare spot in lateral fovea; hair over outside 1/8 of base directed toward rounded posterior angles, other hair along base directed toward middle of base.

Elytra at humeri wider than pronotum, 14 mm, then quickly expanding to 16 mm and continuing almost parallel toward apex. Edges of elytra finely, cariniformly margined, with narrow, smooth, hairless border decreasing gradually from humeri to posterior 1/4 where hair reaches edge. Humeri shining and hairless, as is the densely, very finely punctate scutellum; scutellum with narrow, smooth, shining, flat, lateral margins. Elytra otherwise completely covered by grayish hair which masks surface sculpture except for small circumscutellar area which shows some close mixed fine and moderate punctures.

Underside clothed with depressed, dense, grayish hair except narrowly along midline of metasternum and more widely at middle of abdominal segments, hairless areas of abdomen extremely finely, densely punctate. Pygidium convex, completely covered by fine dense hair, but thinly enough to see same extremely fine dense punctation so visible at middle of abdominal segments. Femora thinly clothed with similar hair. Tarsi as long as tibiae, 8 mm.

Allotype Female. Length 24 mm, width 13 mm. Dark brown, shining dorsal side practically without hair. Head differs from male in having clypeal teeth flattened posteriorly and having low, smooth, arcuate, transverse tubercle along middle 1/5 of clypeo-frontal suture instead of cephalic horn. Surface, including ocular canthi, finely scabriculate except for smooth shining area over middle 1/3 of base. Pronotum with small group of erect hairs at extreme sides, another small group at middle of base; basal marginal bead almost nonexistent; entire surface covered by coarse irregularly spaced punctures which become closer and run together approaching anterior angles, some fine scabriculate sculpture just inside lateral margins. Scutellum densely finely punctate with smooth margins. Elytra shining, without hair, sutural interval distinct, 3 others vaguely outlined; 1st interval coarsely distinctly punctate, punctures separated by 1-2 diameters, other intervals gradually less and less distinctly so, with punctures becoming smaller and shallower; entire elytra with intermixed fine punctures. Pygidium transversely convex and finely punctate over anterior 1/3, then concave and finely scabriculate to apex; covered by very fine hair, longer and denser basally, especially so at sides, much shorter and sparser over concave area to apex. Underside as in male except that bare areas of abdominal segments are smoother and lack very dense fine punctures.

Holotype male, allotype female and two female paratypes collected 12 September 1973, clinging to an *Acacia* by side of road, 8 miles north of San Felipe, Baja California, Mexico, by Dr. Rudolph Lenczy for whom the species is named. One male paratype from same locality, 8 Oct. 1973, by D. G. Marqua. The larger paratypes measure 31 mm in length by 18 mm in width. Holotype, allotype and one paratype in Dr. Lenczy's Collection, with the understanding that the holotype will be returned eventually to the National Museum of Natural History collection. Paratypes in National Museum Collection.

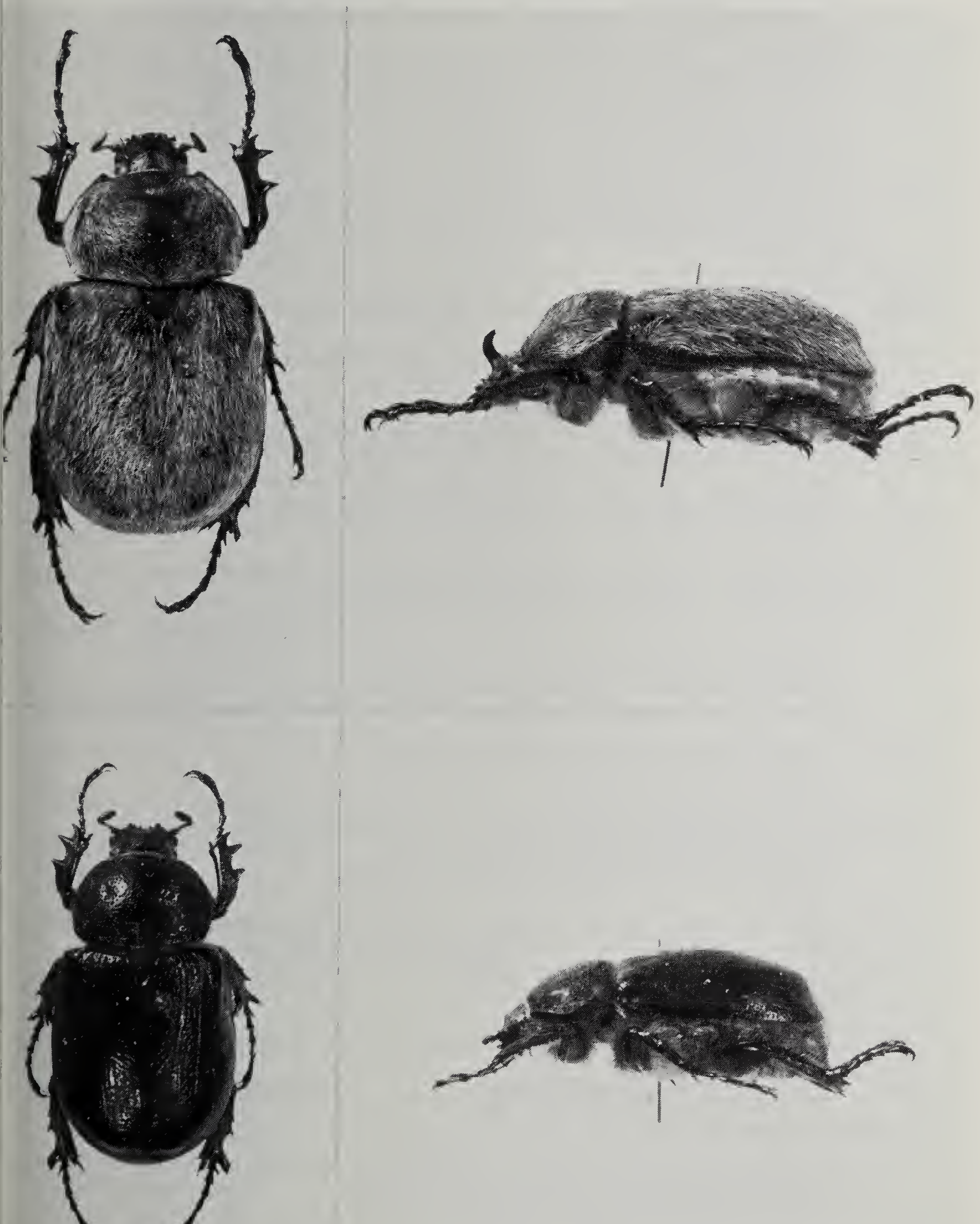

Fig. 1. Dorsal and lateral views of male (top) and female (bottom) of *Megasoma lenczyi* Cartwright, new species.

MODIFICATION OF HARDY'S KEY TO *Megasoma* OF NORTH AND CENTRAL AMERICA

1.	Individuals with a prominent horn on the front, this horn bifurcate at the apex; prothorax usually with anterior angles produced and forming prominent projections (males)	2
1′.	Individuals with no more than tubercles on the front; prothorax unarmed (females)	13
2(1).	Upper surface of elytra and portions of head and thorax clothed with fine tomentose pile, or elytra and thorax glabrous; if glabrous a shiny or dull uniform black; over 60 mm in length	3
2′.	Upper surface of elytra either with recumbent hairs or elytra glabrous; species either not black, or species with a well developed prothoracic horn; length under 50 mm (*thersites* group)	6
3(2).	Species with glabrous elytra and prothorax. Panama and South America	4
3′.	Species with portions of prothorax and elytra covered with tomentose covering	5
4(3).	Anterior angles of the prothorax directed anteriorly, parallel to each other; dull black. Panama and South America	*M. actaeon* (Linnaeus)
4′.	Anterior angles of prothorax diverging anteriorly; highly glossy black. South America	*M. mars* (Reiche)
5(3′).	Anterior angles of prothorax produced anteriorly. From Cordoba in Veracruz, Mexico to Panama	*M. elephas elephas* (Fabr.)
5′.	Anterior angles of prothorax produced laterally. From Sinaloa south to Michoacan, Mexico, along the coast	*M. elephas occidentalis* Bolivar y Pieltain *et al.*
6(2′).	Upper surface with recumbent pale hair	11
6′.	Upper surface glabrous	7
7(6′).	Prothorax with a median, anteriorly directed horn. Southern Sonora and northern Sinaloa, Mexico	*M. pachecoi* Cartwright
7′.	Prothorax at most with a median tubercle	8
8(7′).	Anterior angles of prothorax produced into acute projections; cephalic horn longer than greatest length of head	9
8′.	Anterior angles of prothorax normal; cephalic horn reduced, less than length of head	10
9(8).	Shining reddish brown. Baja California Sur (female unknown	*M. lecontei* Hardy
9′.	Dull black. Southern Arizona	*M. punctulatus* Cartwright
10(8′).	Prothorax with a small smooth spot just posterior to midpoint, and anterior to the smooth spot a small swelling in place of prothoracic horn in other species	*M. cedrosa* Hardy
10′.	Prothorax without smooth spot or swelling	*M. sleeperi* Hardy
11(6).	Anterior angles of prothorax normal, not produced anteriorly	*M. lenczyi* Cartwright, new species
11′.	Anterior angles of prothorax produced forward	12

12(11′). Distance between anterior angles of prothorax nearly 2 times width of head. Baja California Sur .... *M. thersites* LeConte

12′. Distance between anterior angles of prothorax less than 1-1/2 times width of head. Texas .... *M. vogti* Cartwright

13(1′). Species over 50 mm in length 14

13′. Species under 50 mm in length (*thersites* group) (females of *M. lecontei* Hardy unknown) 17

14(13). Elytra with apical two-thirds tomentose; prothorax rugose, but without a posterior "crest;" with occasional lateral pubescence 16

14′. Elytra glabrous; prothorax with very rugose sculpture, and a definite central "crest" posteriorly. Panama and South America 15

15(14′). Upper surface glossy; head with a binodose cephalic tubercle. South America .... *M. mars* (Reiche)

15′. Upper surface dull; head with an acute cephalic tubercle. Panama and South America .... *M. actaeon* (Linnaeus)

16(14). From Sinaloa, Mexico, south to Michoacan, Mexico, along the coast .... *M. elephas occidentalis* Bolivar y Pieltain, et. al.

16′. From Cordoba, Vera Cruz, Mexico, and Arriaga, Chiapas, Mexico, east and south to Panama .. *M. elephas elephas* (Fabricius)

17(13′). Upper surface of apical portions of elytra and often lateral areas of prothorax with recumbent pale hair. Baja California 18

17′. Upper surface of elytra glabrous 20

18(17). Clypeal tubercle arising out of clypeal plane, usually not binodose. Clypeus semicircularly emarginate, with angles produced 19

18′. Cephalic tubercle on a well developed tumid process; tubercle impressed to such a degree as to be binodose. Anterior angles of clypeus spiniform, arising abruptly from the rather straight leading edge of the clypeus. Southern Texas .... *M. vogti* Cartwright

19(18). Scutellum densely, finely punctate with flat, smooth shiny margins. Baja California .... *M. lenczyi* Cartwright, new species

19′. Scutellum shining, minutely punctate or with few punctures just inside the flat lateral margins 22

20(17′). Terminal concave area of pygidium with very few hairs or completely glabrous 21

20′. Terminal concave area of pygidium hairy. Southern California .... *M. sleeperi* Hardy

21(20). Clypeal tubercle transverse, often binodose. Southern Arizona .... *M. punctulatus* Cartwright

21′. Clypeal tubercle acute. Sonora and Sinaloa, Mexico .... *M. pachecoi* Cartwright

22(19′). Tubercle on head impressed in center to some degree, usually sufficient to give the impression of 2 tubercles; or tubercle transverse, blunt. Southern Baja California Sur .... *M. thersites* LeConte

22′. Tubercle on head acute, not transverse or blunt .... *M. cedrosa* Hardy

NOTE ON AN ALASKAN ELATERID

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Between 16-30 June 1974, I had the pleasure of visiting Fairbanks, Alaska, along with several colleagues from the 5503rd U.S.A.R. Hospital. Accompanied by David L. Vincent, I was able to do some collecting during our spare time. On 19 June Dave collected 8 elaterid adults, 20 miles north of Fairbanks, resting in flowers. The same day, I took a similar adult, near Bassett Hospital, at Ft. Wainwright. I subsequently determined these beetles as *Eanus decoratus* Mannerheim (Brown, 1930). Dr. E. C. Becker, Canadian National Collection, Ottawa, kindly confirmed my identification. Portions of the plant, including flowers, were brought to Dr. D. B. Dunn, Curator, University of Missouri Herbarium, who determined it as *Vaccinium uliginosum* L., the Bog Blueberry or Bog Bilberry, a member of the Ericaceae. Potter (1962) reported *V. uliginosum* to be in bloom 15 June in the Fairbanks area.

Rambousek (1929) reported *Agriotes ustulatus* L. on umbelliferous and other plants, Langenbuch (1932) reported *Agriotes obscurus* L. and *A. lineatus* L. on cereal crops, and Cockerham and Deen (1936) stated that corn pollen was the chief diet of adults on *Heteroderes laurenti* Guerin. Gut analyses for pollen were made, but no conclusive evidence could be drawn. Since all 9 beetles were found in the blossoms of *V. uliginosum* and were profusely covered with pollen, they were presumed to be feeding there. Brooks (1960) collected *E. decoratus* in 3 Canadian Provinces, on larch and spruce. Had time allowed, *V. uliginosum* might have proved a good collecting site for him also.

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PLACEMENT OF THE BEETLE GENUS *EPARCHIUM* (COLEOPTERA: MELYRIDAE)

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ABSTRACT

Eparchium is transferred from the Staphylinidae to the Melyridae and placed as a junior synonym of *Apterodasytes,* a member of the Dasytini. Eparchiini is a junior synonym of Dasytini. The 2 species of *Apterodasytes* are distinguished by color. A lectotype is designated for *A. paradoxa.*

In 1934 Bernhauer described the tribe Eparchiini for the new South African genus and species *Eparchium paradoxum.* He placed the tribe in the Staphylinidae between the Omaliini and Oxytelini. Since the Omaliini and Oxytelini were subsequently elevated to subfamilies and since *Eparchium* was not discussed in the literature after its discovery, the Eparchiini has neither been placed in a subfamily nor elevated to subfamily.

While studying *Eparchium* to determine its taxonomic position I realized that it seemed to be a strange looking rove beetle—it looked "too loosely constructed" for a staphylinid. The suspicion that it was not a staphylinid was confirmed when dissection revealed a cucujoid type of aedeagus, i.e., the tegmen (basal piece) envelops the median lobe (fig. 1, 2).

Eparchium paradoxum obviously was placed in the Staphylinidae because more than 3 abdominal terga are exposed from under reduced elytra. In addition, the 5 filiform tarsomeres, the filiform antennomeres, the absence of more than 2 sclerotized basal terga, the equally long tarsal claws, and the absence of femoral plates of the metacoxae all supported recognition of *Eparchium* as a staphylinid. However, the Staphylinidae do not have a basal piece on the aedeagus; the parameres are attached directly to the median lobe. In *E. paradoxum* the basal piece is fully developed and modified into a tegmen that surrounds the median lobe, a feature that immediately excludes the species from the Staphylinidae and places it in the Cucujiformia (Crowson 1960, 1970b).

Within the Cucujiformia, *Eparchium paradoxum* is placed in the Cleroidea because it has 5 filiform tarsomeres with each article exposed, procoxae that are conical and project from the coxal cavities, open procoxal cavities, exposed protrochantins, and no scutellary striole. Further, the tegmen has 2 small blunt outgrowths posteriorly (parameres) which are not articulated (as in fig. 5, 6). According to the definition of the family given by Crowson (1955, 1964, 1970a), *Eparchium* belongs in the Melyridae.[1] Within the family, *Eparchium* is placed in the Dasytinae because it lacks clubbed antennae, has appendiculate tarsal claws, has free abdom-

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[1] Contrary to the statement by Bernhauer (1934), the mandibles of *E. paradoxum* are bidentate (fig. 3).

inal sterna, the first (visible) of which is raised into a keel between the hind coxae, has the first 2 tarsomeres equally long, and lacks protrusible vesicles at the sides of the prothoracic and abdominal segments.

After searching the dasytine literature for species with short elytra from South Africa, the description of *Apterodasytes staphylinoides* was found to fit *Eparchium paradoxum* almost perfectly. Subsequent comparison of part of the type series of *A. staphylinoides* with part of that of *E. paradoxum* confirmed that the 2 species can be distinguished only by color and therefore should be regarded as congeneric. *Apterodasytes* (Champion 1923) was described before *Eparchium* (Bernhauer 1934), and inclusion of *Eparchium* in the Dasytini as a synonym of *Apterodasytes* makes Eparchiini a junior synonym of Dasytini (**new synonymies**).

Whether there are 2 species or not is problematical. Among the series labelled as *A. staphylinoides* and *E. paradoxum* there are 2 forms: one is entirely black to blackish brown; the other is black to blackish brown with a median, moderately large reddish orange or reddish yellow maculation

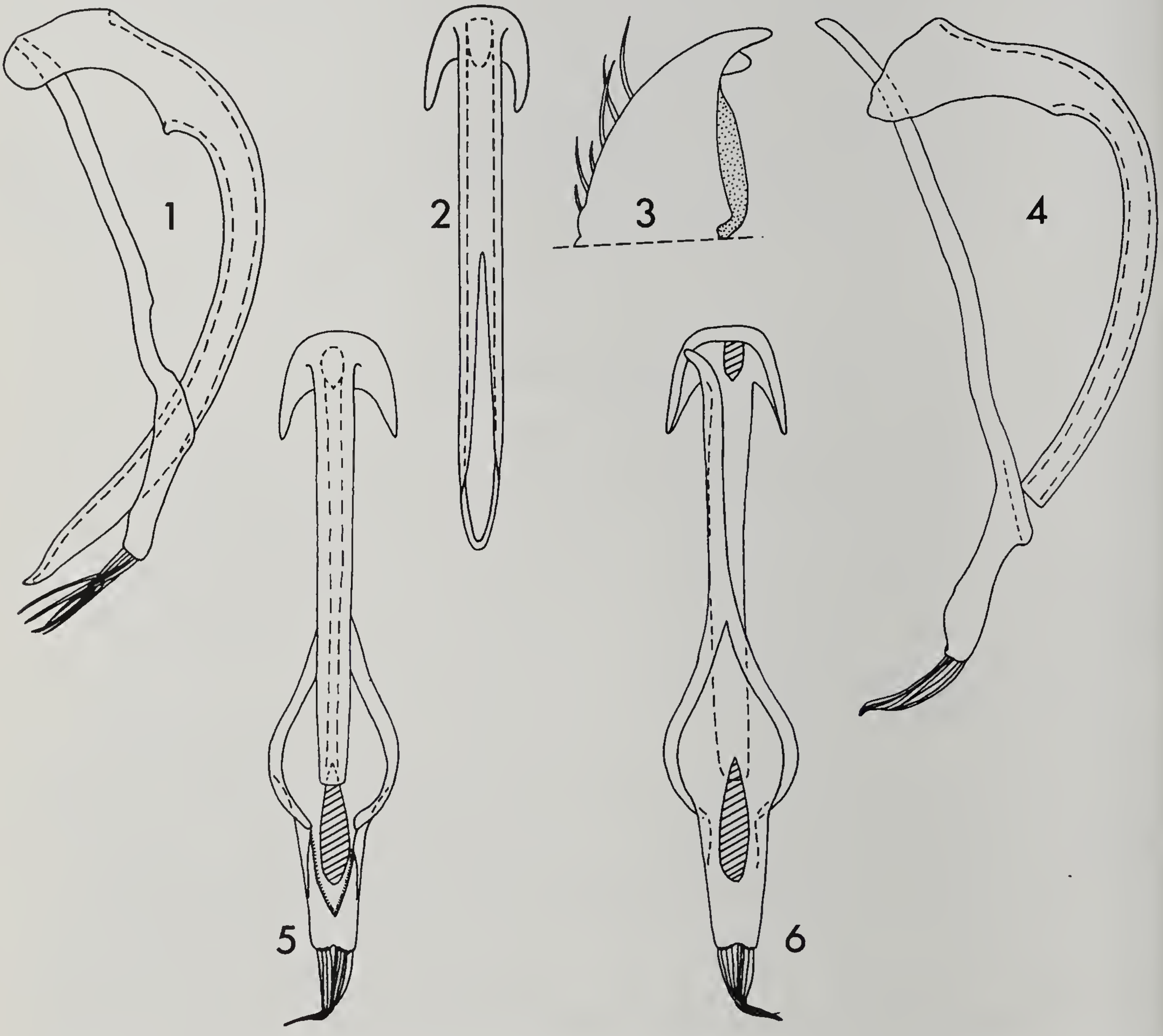

Fig. 1-3. *Apterodasytes paradoxa* (Bernhauer): 1) Aedeagus, lateral view; 2) Median lobe, dorsal view; 3) Mandible, left.

Fig. 4-6. *Apterodasytes staphylinoides* Champion, aedeagus: 4) Lateral view; 5) Dorsal view; 6) Ventral view.

on the basal 2 abdominal terga, and the basal 2 abdominal sterna are almost entirely reddish yellow. Champion (1923) described *A. staphylinoides* as being black, and all type material is from Prince Albert, South Africa. The 2 syntypes I studied from the type locality of *A. staphylinoides* are black. Material subsequently identified as *A. staphylinoides* has both the black and bicolored forms.

Bernhauer (1934) described for *E. paradoxa* both the black and bicolored forms but neither a holotype nor lectotype has been selected. Since the bicolored form is illustrated (Bernhauer, 1934, pl. XIV, fig. a) with the description it seems best to select a specimen of this form as the lectotype and accordingly I do so.[2] Such selection precludes the necessity of naming the bicolored form if the 2 are actually different species.

The apex of the median lobe of the bicolored form (fig. 1, 2) seems to be attenuate with a long, dorsal ostium, and that of the black form (fig. 4, 5) seems to be truncate with a small apical ostium.[3] The apex of the median lobe of the black form may have been broken, thus giving an apparent aedeagal difference. I had no additional males of the black form to check this possibility.

Until further study is made of the 2 forms, it is best to regard *Apterodasytes* as having 2 species, a black one, *A. staphylinoides* Champion, and a bicolored one, *A. paradoxa* (Bernhauer), **new combination.**

Thanks are due to Henry Dybas of the Field Museum of Natural History and Peter Hammond of the British Museum (Natural History) for the loan of the specimens used in the study.

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[2] The lectotype deposited in the Field Museum of Natural History has the following label data: "Cape Province, Matjesfontein, 22-23. X. 1928; S. Africa, R. E. Turner, Brit. Mus., 1928-491; Eparchium n.g. paradoxum Brnh., Cotypus; Paradoxum Brnh., Typus, Eparchium." I have placed on the pin a lectotype label.

[3] The aedeagus of only one specimen of each form was examined.

A CASE OF HOMONYMY IN THE TACHYINA (COLEOPTERA: CARABIDAE: BEMBIDIINI)

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G. G. Perrault (*in litt.*) pointed out to me that *Tachymenis* Motschulsky (1862:27), type species *Bembidium flavicaudus* Say, was preoccupied by *Tachymenis* Weigmann (1835:251), a genus of culubrid snakes in South America. Motschulsky's name is therefore a junior homonym and, according to Articles 53 and 60 of the International Code of Zoological Nomenclature, must be replaced. The next available valid name (Erwin, 1974) is *Mioptachys* Bates (1882:144), type species *Mioptachys trechoides* Bates. Following Erwin (1974), the resulting **new combinations** are as listed: *Mioptachys autumnalis* (Bates), *M. crucigera* (Bates), *M. cucujoides* (Bates), *M. flavicauda* (Say), *M. marginicollis* (Motschulsky), *M. insularis* (Darlington), *M. melania* (Bates), *M. neotropica* (Csiki), *M. noctis* (Darlington), *M. ocularis* (Casey), *M. parallela* (Bates), and *M. xanthura* (Bates). *Mioptachys trechoides* Bates and *M. oopteroides* Bates are original combinations.

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RECORDS AND DESCRIPTIONS OF SOME SOUTHWESTERN CERAMBYCIDAE (COLEOPTERA)

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ABSTRACT

Elaphidionoides occidentalis and *Aneflomorpha rectilinea yumae* are described as new. The Neotropical *Mannophorus forreri* Bates and *Sphaerion exutum* (Newman) are recorded from the southwestern United States for the first time.

Two previously undescribed members of the tribe Elaphidionini have been found during several years of collecting in the vicinity of Yuma, Arizona. Both infest *Salix* sp., and both are closely related to species which occur from south-central Arizona into Mexico. The southern Colorado River basin is a rather restricted habitat, surrounded as it is by Sonoran desert. As in the endemic *Aneflus protensus pallidus* Tyson, *Dendrobias mandibularis reductus* Casey, and *Stenosphenus nigricornis* Fisher, the 2 species described below tend to have a lighter colored integument; related forms to the east and south are darker. The genus *Elaphidionoides* Linsley has been known previously in the Southwest only by *E. gibbulus* (Bates).

Elaphidionoides occidentalis Giesbert and Hovore, **new species**
(Fig. 1)

Description: MALE.—Form moderately robust; integument reddish brown, clothed with irregular patchy appressed yellowish pubescence. Head coarsely punctate between eyes, less coarsely behind, punctures somewhat obscured by pubescence; antennae surpassing elytral apices by at most 2 segments, segments 3 to 7 armed with internal spine at apex, segments 1 to 6 or 7 moderately densely clothed with recumbent pubescence and fringed internally with suberect longer hairs, distal segments clothed with very short suberect pubescence, segment 3 longer than 4, segments 3, 5, 6, and 7 subequal, segments 8 to 10 successively shorter, segment 11 longer than 10. Pronotum rounded at sides; disk coarsely shallowly confluently punctate, punctures shallower and slightly larger than those at base of elytra, with elevated median longitudinal polished area, and with 10 or more dorsal and lateral patches of appressed yellowish pubescence; prosternum rugose, transversely impressed in front of coxae; metasternum shallowly punctate, clothed with suberect pale hairs. Elytra wider at base than pronotum, at most 2½ times as long as basal width; surface somewhat coarsely and deeply punctate at base, punctures partially obscured by pubescence, becoming gradually smaller and more shallow apically; pubescence consisting of single suberect hairs borne by punctures, and small patches of appressed yellowish hairs fairly thickly scattered in a feebly longitudinally irrorate pattern; apices shallowly emarginate or truncate, inner angle usually spinose, outer angle at most dentate. Legs moderately slender, femora shallowly punctate and pubescent. Abdomen with shallow punctures bearing fine hairs; sternites 4 and 5 nearly equal in length, 5 broadly rounded at apex. Length 15-22 mm.

FEMALE.—Form more robust than male. Antennae short, at most attaining elytral apices. Pronotum coarsely contiguously punctate, punctures larger than those at base of elytra. Abdomen with sternite 5 longer than 4, rather narrowly rounded at apex. Length 18-20 mm.

TYPES.—Holotype male, allotype, (California Academy of Sciences) and 1 female paratype from CALIFORNIA, Imperial County, Laguna Lake, under bark of *Salix* log, 8-VII-69 (E. Giesbert and E. Weidert). 14 additional paratypes as follows: CALIFORNIA: 1 male, Imperial County, Laguna Lake,

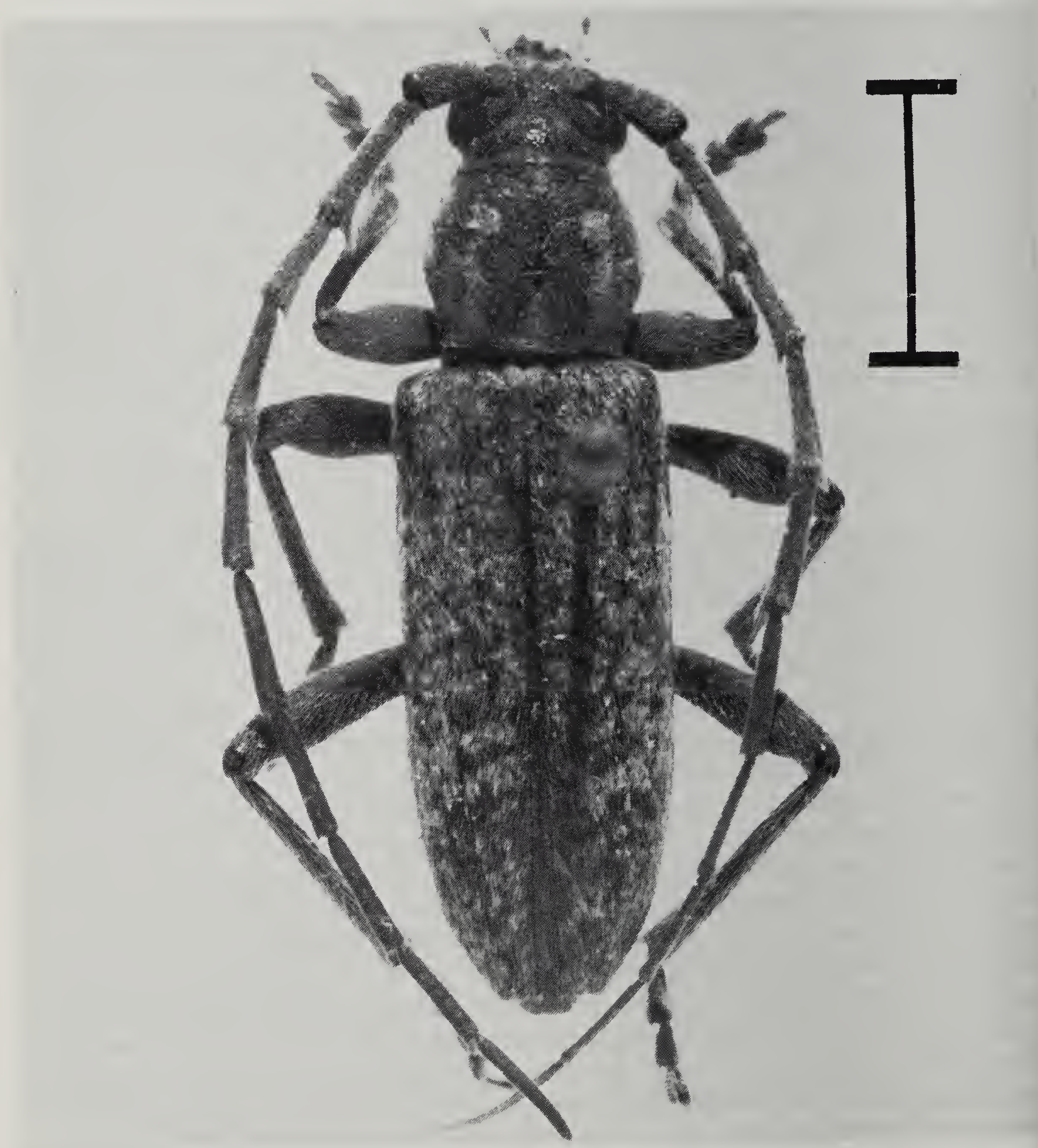

Fig. 1. *Elaphidionoides occidentalis* Giesbert and Hovore male, line represents 5 mm.

reared from *Salix,* emerged 3-VII-70 (E. Giesbert); 3 males, 1 female, Imperial County, Laguna Dam, at ultraviolet light, 4-VIII-73, 1 male, same locality, 3-VII-72 (A. E. and D. S. Lewis); 1 male, Imperial County, 2 mi. N. Laguna Dam, Colorado River, 21-VII-74 (J. S. Cope); 1 male, Imperial County, Brawley, at white light, 1-VII-66 (D. G. Marqua). ARIZONA: 1 male, 1 female, Yuma County, Morelos Dam, reared from *Salix,* emerged 26, 27-VII-73 (F. T. Hovore).[1] One additional female, not named a paratype, in collection of AMNH, labelled simply "Yuma, Cal".

Diagnosis: This species is related to *E. gibbulus* (Bates), to which it will key in Linsley's 1963 treatment of the genus, and with which it agrees in having the elytral spines short, the body robust, and in the form of the pronotum. It may be easily distinguished from that species, however, by the generally lighter color, denser pubescence, shorter, more pubescent antennae, deeper basal elytral punctures, and shorter, more robust form.

Natural history: *E. occidentalis* has been found working beneath the bark of recently dead major limbs of *Salix.* The larvae construct meandering galleries packed with granular frass composed of both bark and wood. Mature larvae either enter the heartwood to construct a pupal chamber, or make a shallow chamber beneath the bark. Pupation generally occurs in June, with adults active in July and August. Infested limbs and small branches examined by the authors were 3 to 7 inches in diameter. Craighead (1923) describes the larva of *E. gibbulus* and records it as ". . . working much as *E. mucronatus,* beneath the bark of dead *Salix, Populus,* and less frequently *Quercus.* It is usually found in somewhat decayed wood, associated with a species of *Acanthoderes.*" We have observed the same associations in the field in south-central Arizona. *E. occidentalis,* however, has thus far been found only in sound, recently dead wood.

Aneflomorpha rectilinea yumae Giesbert and Hovore, **new subspecies**

Description: MALE.—Form elongate, small to moderate sized; integument testaceus; pubescence moderately dense, yellowish, subrecumbent and suberect. Head closely, coarsely punctate, pubescence moderately dense, especially dense within emarginations of eyes; interantennal depression distinct, antennal tubercles fairly prominent; palpi unequal, last segment slightly expanded; antennae surpassing elytral apices by at least 1 segment, segments 3 to 6 spinose at apices, 7 sometimes with a small tooth, segments 3 to 8 distinctly carinate dorsally, 9 vaguely so, basal segments clothed with subrecumbent hairs, distal segments rather densely clothed with very short appressed and erect pubescence, long suberect hairs numerous basally, segments 3 and 5 to 10 subequal, all longer than 4, 11 slightly longer, appendiculate. Pronotum longer than wide, sides broadly rounded, slightly constricted at base and apex; disk coarsely, densely, confluently punctate, rugose appearing, sometimes with vague median callus; pubescence moderately dense, subrecumbent, partially obscuring surface, longer, erect hairs present laterally; prosternum very shallowly impressed, anterior portion transversely rugose, posterior coarsely, rugosely punctate, densely pubescent. Scutellum very densely pubescent. Elytra over 3½ times longer than wide; base coarsely separately punctured, punctures becoming finer and shallower apically; pubescence moderately dense, subrecumbent, not obscuring punctation, with scattered longer suberect hairs, especially at margins of disk; apices emarginate, bidentate. Legs slender; femora coarsely densely punctate, rather sparsely pubescent; tibiae carinate. Abdomen moderately densely shallowly punctate, densely pubescent; apex of sternite 5 shallowly emarginate or truncate. Length 10-18mm.

FEMALE.—Antennae shorter than body; apex of abdominal sternite 5 subtruncate. Length 10-18 mm.

TYPES.—Holotype male, allotype (California Academy of Sciences), and 4 paratypes (3 males, 1 female) from ARIZONA: Yuma County, Morelos Dam, beaten from *Salix,* 10-VI-72 (E. Giesbert). Additional paratypes from same locality as follows: 4 males, 1 female, reared from girdled *Salix* branches, emergences 10-V, 16-V, and 6-VI-73 (F. T. Hovore); 4 males, 2 females, 22-VI-71, (E. Giesbert).

Diagnosis: The testaceus integument, and yellowish pubescence, which is especially dense on the scutellum and in the emarginations of the eyes, will separate *A. rectilinea yumae* from the nominate subspecies. In Linsley's 1963 key to the genus *Aneflomorpha, A. r. yumae* will run to *A. citrana* Chemsak, but differs from that species by the longer elytra, somewhat lighter color, and slightly thicker pubescence. In addition, in the material examined by us, both subspecies of *A. rectilinea* have the base of the pronotum more than 2/3 as wide as the elytra at the humeri. In *A. citrana* the base of the pronotum is less than 2/3 the humeral width of the elytra. Linsley, in his 1963 discussion of *A. rectilinea,* states the need for more biological information in order to recognize segregates. We feel that this form should be segregated on the basis of host information gained by rearing, and by the characters enumerated above.

Natural history: Unlike *A. r. rectilinea,* which is recorded as having been collected on *Quercus* and *Baccharis* (Linsley, 1963), host associations for *A. r. yumae* are with *Salix.* The larvae girdle small branches ½ to 1½ inches in diameter, which often remain hanging loosely in the tree. The girdled portion is worked toward the distal end, and galleries are filled with loose granular frass. Pupal chambers are plugged with stringy frass. The girdled branches serve as host for several other beetles, including another cerambycid *(Stenosphenus nigricornis* Fisher), and a buprestid (*Hesperorhipis* sp.).

Mannophorus forreri Bates

Mannophorus forreri Bates, 1885, Biologia Centrali-Americana, Coleoptera 5:327, 436, pl. 21, fig. 24.

This species, previously known from the state of Durango, Mexico, and illustrated in the Biologia Centrali-Americana (Bates, 1885), was taken on Kitt Peak, Cochise County, Arizona, by David G. Marqua in September 1971. It has since been collected in large numbers in the same area on flowers of various Compositae.

Sphaerion exutum (Newman)

Nephalius exutus Newman, 1841, Entomologist, 1:93.

Sphaerion exutum Gounelle, 1907, Bull. Soc. Ent. France, 1907:240; Linsley, 1961, Pan-Pacific Ent. 37:169-170.

This species, previously known from Brazil and Argentina (Blackwelder 1946), and from Chiapas, Mexico (Linsley 1961), is also a new record for U. S. Cerambycidae. It was collected by us in May 1972 on trunks of living ebony blackbead trees, *Pithecellobium flexicaule* (Benth.) in Bentsen Rio Grande Valley State Park, Hidalgo County, Texas. Six specimens were taken at that time, 2 more the following year by A. E. Lewis. The identification was verified by E. G. Linsley.

ACKNOWLEDGMENTS

We are indebted to E. Gorton Linsley and John A. Chemsak, University of California at Berkeley, for assistance and for reviewing the manuscript, and to Dr. Charles Hogue, Los Angeles County Museum of Natural History, for his help with the photograph. Appreciation is also expressed to David G. Marqua, Arthur E. Lewis, James S. Cope, and Edward Weidert for the loan of material.

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[1] Also 4 males, same locality, reared from *Salix* logs, emerged 12-IX-75 and 5, 10-I-76 (E. Giesbert and F. Hovore).

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INSTANT RELAXING OF INSECTS

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A recurring problem for coleopterists, and particularly for students of Staphylinidae, is that in dried mounted specimens important structures are often obscured by appendages or by curling or twisting of the specimen at death. In many staphylinids it is necessary to lift the front coxae to determine the structure of the intercoxal parts. In some linear species poorly mounted specimens may have much of the under surface hidden because of their tendency to curl on drying. In other Coleoptera a leg may hide an important suture; or it may be advantageous to reposition an antenna for comparison of the segments or to make a drawing. In such cases it is necessary to relax the specimen in order to realign the parts. There are several widely used methods of doing this, almost all of them tedious and time-consuming.

A method which greatly simplifies and at the same time improves on previous processes was reported in Wheeler and Wheeler (1963), a work unlikely to come to the attention of general entomologists. They said on page 42, "Relaxing fluid: 380 ml 95% alcohol; 230 ml water; 95 ml ethyl acetate; 7 ml benzene. Dip a small water-color brush (or even a dissecting needle) in the fluid and touch it to the part of the ant to be relaxed. The effect is almost instantaneous, but for the sake of safety one should wait at least a minute." On trying this method we found it so immediately effective that we wish to call it to the attention of Coleopterists.

We noticed that the formula was similar to that of Barber's solution. On applying a drop of Barber's solution with a small camel's hair brush to the antenna of a medium sized (5 mm) staphylinid we got complete flexibility in 3 seconds. Barber's solution, which is widely used as a preservative because specimens remain completely relaxed in it, can be made by the following formula:

15 parts 50% alcohol
3 parts ethyl acetate
1 part benzene

Newton and Peck (1975) suggested the following preservative for keeping specimens relaxed:

70% acetone
25% water
5% benzene

We found that this was an equally effective relaxing fluid when used in the same manner; toluene or xylene may be substituted for the highly toxic benzene, but neither is as satisfactory. This substitution was not possible with either Wheelers' solution or Barber's solution.

To move legs by this method it is necessary to allow about one minute as suggested by the Wheelers. The union of head and thorax and that of prothorax and mesothorax also require more time for full relaxation. Do not allow the fluid to dissolve the glue securing the insect to the point, and do not move appendages to which relaxing fluid has not been directly applied. With a little care, the major body parts of poorly mounted specimens can be realigned and when moved to their new positions tend to remain there, thus transforming what may have been almost useless material into splendid museum specimens.

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NOTES ON THE TIGER BEETLE HOLDINGS OF THE NEVADA STATE DEPARTMENT OF AGRICULTURE (COLEOPTERA: CICINDELIDAE)

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Abstract

The cicindelid holdings of the Nevada State Department of Agriculture are reviewed. The holdings represent 18 taxa, all members of the genus *Cicindela (sensu* W. Horn). The majority of specimens were collected in areas of Nevada not covered in previous literature. Five *C. tranquebarica* Herbst populations are treated as races rather than subspecies until additional distributional data becomes available. Shortcomings of trinomial application to some western *C. tranquebarica* populations are discussed.

The Cicindelidae of Nevada were listed by LaRivers in 1946. Most localities in that list are in human population centers and fairly accessible by conventional vehicles, whereas many suitable cicindelid habitats in Nevada are accessible only by unconventional vehicles; i.e., four-wheel drive vehicles, motorcycles, and aircraft. For this reason I believe that a complete, or even near-complete, work on the tiger beetles of Nevada will not become a reality until the distant future. It would seem logical, then, to add to the faunal knowledge of Nevada in a patchwork fashion until enough material becomes known for a major faunistic work. This action should aid students doing "gamma" work in the various species complexes.

In April of 1974 I had the opportunity to work on the cicindelid holdings of the Nevada State Department of Agriculture. Many of the specimens were collected in some of the more inaccessible areas alluded to above. Most of the specimens represent the so-called "common species".

For the sake of convenience, all localities given below are in alphabetical order; and Rivalier's (1954) phylogeny, with a slight modification, is followed.

Cicindela oregona oregona LeConte

Churchill Co., 8 mi. N Fallon, 19-VII-67, G. D. Cooney; Douglas Co., 7 mi. SE Gardnerville, 23-VIII-70, P. C. Martinelli; 6 mi. N Genoa, 9-V-69, C. A. Herlinger; Elko Co., 20 mi. N Carlin, 11-VI-58, F. D. Parker; Jarbidge River, 11-IX-68, R. C. Bechtel & P. C. Martinelli; Lamoille Canyon, 14-IX-57, R. C. Bechtel; Humboldt Co., Paradise Valley, 16-VIII-64, G. D. Cooney; Lander Co., Kingston Canyon, 12-VI-59, F. D. Parker; Nye Co., Peavine Ranch, 29-VII-64, G. D. Cooney; 10 mi. NW Round Mountain, 20-IV-59, R. C. Bechtel; Storey Co., Lagomarsino Canyon, 9-IX-71, G. M. Nishida; Washoe Co., Galena Creek, 8-VI-58 & 29-V-69, F. D. Parker; 1 mi. S. Mustang, 9-V-59, F. D. Parker, Price Lake, 12-VII-68, R. C. Bechtel; 1 mi. E

Steamboat, 28-III-68, R. C. Bechtel; 10 mi. SE Sutcliffe, 5-VI-60, F. D. Parker; Verdi, 10-IV-60, F. D. Parker.

There is little readily observed phenotypic variation in these samples.

Cicindela oregona maricopa Leng

Clark Co., 12 mi. S Mesquite, 19-IV-60, R. C. Bechtel; Lincoln Co., Beaver Dam State Park, 12-IX-73, R. C. Bechtel.

The Lincoln Co. sample contains 20 specimens of the *maricopa* phenotype. All are deep blue or blue-green with blue or green heads and pronota and wide lunules. The Clark Co. sample is small but of the same phenotype as the Lincoln Co. sample.

Cicindela montana LeConte

Elko Co., Jarbidge River, 11-IX-68, R. C. Bechtel & P. C. Martinelli.

The sample contains 6 specimens that are inseparable from California samples of this species. LaRivers (1946) listed nominate *C. longilabris* from Elko Co. but to my knowledge the nominate form is restricted to the northeastern United States (Minnesota and eastward) and Canada. LaRivers' "*C. longilabris*" is probably *C. montana* as these 2 species strongly resemble one another.

Cicindela purpurea auduboni LeConte

Elko Co., 10 mi. SE Halleck, 22-IX-60, R. C. Bechtel; Lamoille Canyon, 18-VI-58, R. C. Bechtel; Washoe Co., Galena Creek, 20-III-60, F. D. Parker; New Year Lake, 9-X-68, R. C. Bechtel & P. C. Martinelli.

All specimens are the typical, green *auduboni* phenotype. This subspecies was reported by LaRivers as *graminea* Schaupp.

Cicindela plutonica leachi Cazier

Pershing Co., 37 mi. E Lovelock, 12-IX-58, C. W. Baker.

This one specimen is bright metallic blue-green and indistinguishable from California samples of this form. It is debatable whether the *leachi* phenotype deserves taxonomic standing, as most of the *C. plutonica* populations known to me contain both the nominate form and the *leachi* form in more or less equal numbers.

Cicindela parowana platti Cazier

Eureka Co., 6 mi. S. Beowawe, 15-IX-57, R. C. Bechtel; Humboldt Co., McDermitt, 26-VIII-59, R. C. Bechtel; Orovada, 19-VII-61, F. D. Parker; Soldier Meadows, 17-VII-68, R. C. Bechtel.

Each of the above localities is represented by only 1 or 2 specimens. No specimens are of the exact *platti* phenotype as they lack the confluent maculation and color of that subspecies. The color ranges from blue-green to green-brown and the lunules, though very wide, are not connected. All have wide descending marginal lines. Until more material becomes available, I assign these to the subspecies *platti* simply because they have less in common with the other 2 named subspecies.

Cicindela tranquebarica Herbst

This species is extremely variable in color and maculation—as evidenced by the dozen or so subspecies currently recognized. In some cases this variation is not only interpopulational but also intrapopulational, as some known populations change color seasonally. This aspect of intrapopulational variation has not been fully evaluated for the western *C. tranquebarica* populations owing to the remoteness of some populations and to the fact that tiger beetle collectors rarely keep sampling a population over the season. Without information concerning intrapopulational variation, names applied to these western *C. tranquebarica* populations are meaningless. A case in point is the population at Owen's Lake, Inyo County, California. If one were to sample this population from early April to the middle of June one would have approximately 5 subspecific phenotypes represented; i.e., *inyo* Fall (green in color with narrow to thick lunules), *kirbyi* LeConte (brown or black in color with very wide lunules), *cibecuei* Duncan (blue in color with wide lunules), *borealis* E. D. Harris (brown or black in color with very narrow lunules), and *parallelonota* Casey (light to dark green in color with thickened lunules). This multiplicity of morphs at Owen's Lake led Fall (1917) to describe 2 new subspecies of *tranquebarica.* This population is one of those in which color changes with the progression of the season. Specimens collected in early April are light green whereas those taken in June are dark brown or black. Also, as with other populations of *Cicindela,* a slight degree of maculation plasticity occurs in this population. Two more examples of this multiplicity of phenotypes involve subspecies treated by LaRivers (1946); he reported *kirbyi* and *owena* Fall (=*inyo*) occurring together at Little Soda Lake and *kirbyi* and *borealis* found together near Reno. I have not seen examples from the 2 above localities, but they apparently vary in maculation as this is the character state used to divide the 3 aforementioned taxa.

With the above in mind, I refrain from placing subspecific names on any of the following *C. tranquebarica* populations, but instead simply refer to them as races. This act is necessitated by the extreme variability of *C. tranquebarica,* the poor character states currently used to delimit taxa within this species, and the paucity of specimens from the following localities.

Cicindela tranquebarica "Beowawe race"

Eureka Co., 6 mi. S Beowawe, 15-IX-57, R. C. Bechtel.

The sample is of 2 specimens, both dark blue in color. At first glance they appear to be the blue phase of subspecies *inyo,* but a closer examination reveals that the lunules are quite different (see Fig. 1).

Cicindela tranquebarica "Jarbidge River race"

Elko Co., Jarbidge River, 11-1X-68, R. C. Bechtel & P. C. Martinelli.

This one specimen is dark green-bronze dorsally, and the lunules are thin and broken at the edges of the elytra similar to those of *borealis.*

Cicindela tranquebarica "Mesquite race"

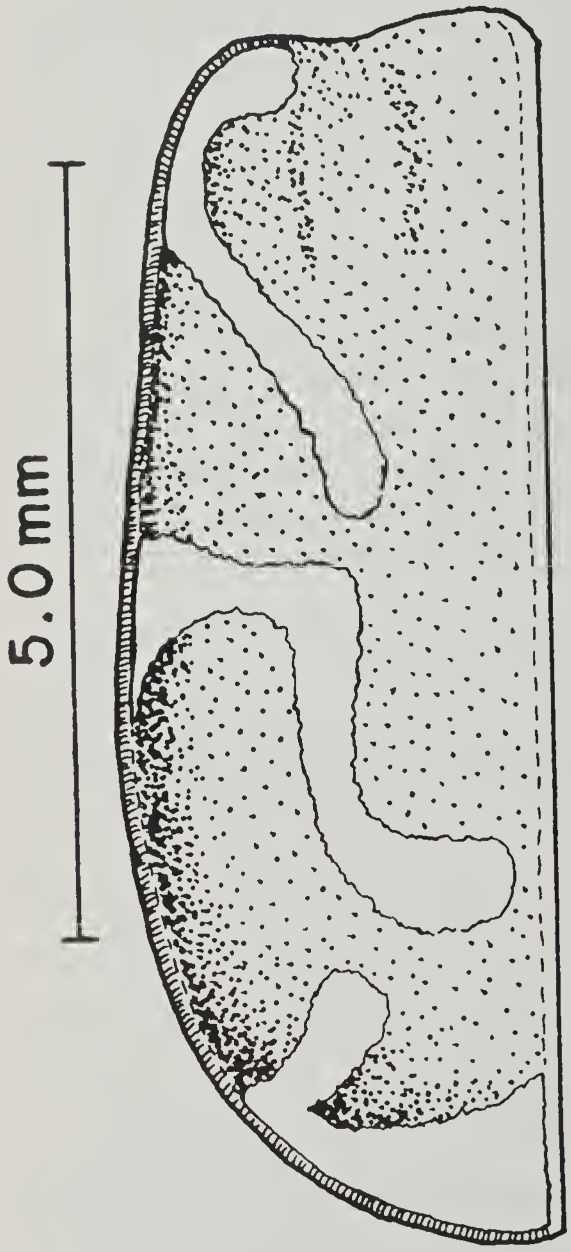
Clark Co., Mesquite, 15-IV-59, R. C. Bechtel.

The sample contains one specimen which is similar to the reddish-brown specimens found along the Virgin River and its tributaries in southwestern Utah. This reddish-brown form represents *moapana* Casey and is found side-by-side with the green *parallelonota* over much of its range in southwestern Utah as reported by Lawton (1972) and verified by material I have collected.

Cicindela tranquebarica "Pahrump race"

Nye Co., Pahrump, 28-III-68, R. P. Johnson.

The single exemplar is nearly identical with the Beowawe specimens except that it is smaller (11 mm) and the humeral lunule is thinner. This beetle was collected only 21 airline miles from the radically different subspecies *arida* A. C. Davis population near Death Valley Junction, California.



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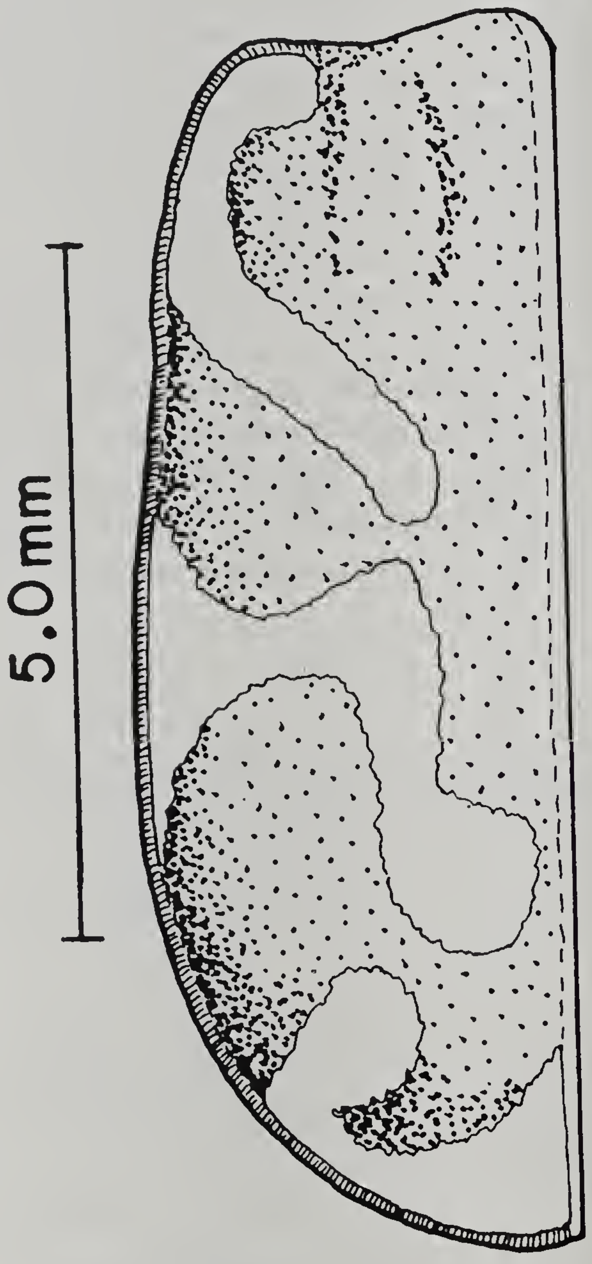

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Fig. 1. *Cicindela tranquebarica* "Beowawe race", dorsal view of left elytron.

Fig. 2. *Cicindela tranquebarica* "Spencer's Hot Springs race", dorsal view of left elytron.

Cicindela tranquebarica "Spencer's Hot Springs race"

Lander Co., Spencer's Hot Springs, 9-IX-72, R. C. Bechtel & G. M. Nishida; Nye Co., Diana's Punch Bowl, 7-IX-72, R. C. Bechtel & G. M. Nishida.

Both samples are composed of larger beetles (14-16 mm), green-brown in color with fairly wide lunules (see Fig. 2).

Cicindela willistoni echo Casey

Churchill Co., 26 mi. N Fallon, 3-VI-59, R. C. Bechtel.

The sample is comprised of 10 specimens. The middle bands of these specimens are considerably wider than in specimens from the Great Salt Lake (type locality for *echo*), but similar to those from Koehn Lake (Kern Co.) and Deep Springs Lake (Inyo Co.) in California.

Cicindela haemorrhagica haemorrhagica LeConte

Churchill Co., Fallon, 13-VIII-72, G. M. Nishida; 8 mi. N Fallon, 19-VII-67, G. D. Cooney; Clark Co., Bunkerville, 11-VI-59, F. D. Parker, 2 mi. NE Henderson, 10-VI-59, F. D. Parker; Logandale, 5-VIII-59, F. D. Parker; 2 mi. S Logandale, 22-VII-66, G. D. Cooney; Humboldt Co., Soldier Meadows, 16-VII-70, R. C. Bechtel & P. C. Martinelli; Twain, 26-VII-72, G. M. Nishida; Lander Co., 6 mi. S Hilltop, 19-IX-67, R. C. Bechtel & P. C. Martinelli; Lyon Co., 12 mi. NE Fernley, 16-VIII-71, G. M. Nishida; Nye Co., Darrough Hot Springs, 30-VII-64, G. D. Cooney; Pahrump, 9-VI-59 & 24-VIII-59, F. D. Parker; 3 mi. NW Pahrump, 27-IX-57, R. C. Bechtel; Pershing Co., Grass Valley, 20-VII-72, G. M. Nishida; Lovelock, 11-VII-66, G. D. Cooney; Seven Devils Springs, 1-VII-70, R. C. Bechtel & P. C. Martinelli.

Most of these samples are heavily marked, typical *haemorrhagica*. However, in 2 localities (Darrough Hot Springs & 2 mi. NE Henderson) this phenotype grades into that of "*pacifica*" Schaupp. The single specimen from 2 mi. S Logandale represents a dramatic deviation from the *haemorrhagica* phenotype as it is metallic green in color.

Cicindela tenuisignata LeConte

Clark Co., Logandale, 3, 5, 10 & 25-VIII-59, F. D. Parker; 2 mi. S Logandale, G. D. Cooney; Nye Co., 3 mi. NW Pahrump, 27-IX-57, R. C. Bechtel.

There is no appreciable variation in any of these samples.

Cicindela punctulata chihuahuae Bates

Clark Co., Logandale, 23-VIII-59, F. D. Parker; Logandale, 13-VII-73, L. W. Barclay, R. C. Bechtel & D. F. Zoller; 2 mi. S Logandale, 22-VII-66, G. D. Cooney; Mesquite, 25-VIII-63, R. C. Bechtel; Mesquite, 22 & 24-VII-65, G. D. Cooney; Mesquite, 17-IX-72, G. M. Nishida; Overton, 6-VIII-71, G. M. Nishida; Lincoln Co., Alamo, 9-VIII-71, G. M. Nishida; Hiko, 22-VIII-72, G. M. Nishida.

All specimens are deep blue or blue-green in color with the characteristic broken lunules.

Cicindela praetextata praetextata LeConte

Clark Co., Bunkerville, 11-VI-59, F. D. Parker; Logandale, 8 & 14-VIII-59, F. D. Parker, Riverside, 11-VI-59, R. C. Bechtel.

All specimens represent the nominate phenotype, with little variation.

Cicindela pusilla imperfecta LeConte

Humboldt Co., Bottle Creek, 13-VIII-60, F. D. Parker; Kings River Valley, 7-VI-61, F. D. Parker; Orovada, 31-V-72, R. C. Bechtel; Paradise Valley, 16-VI-60, F. D. Parker; Soldier Meadows, 20-VII-67, 14 & 16-VII-70, R. C. Bechtel & P. C. Martinelli.

No localities are represented by more than 6 specimens, and all samples vary in coloration; all samples have representatives that display the brown *imperfecta* phenotype and every sample has at least one blue individual or one with a bluish tinge.

Cicindela lemniscata lemniscata LeConte

Clark Co., Logandale, 10-VIII-59, light trap, F. D. Parker.

All specimens are typical *lemniscata,* inseparable from those found in southeastern Arizona.

Acknowledgments

I would like to thank Dr. Robert C. Bechtel of the Nevada State Department of Agriculture for allowing me to study the specimens used in this paper and Mr. Saul Frommer of the University of California, Riverside for his critical review of the manuscript.

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THE COLEOPTERISTS SOCIETY

MINUTES OF ANNUAL MEETING

The 8th annual meeting of the Coleopterists Society was held 31 November, 1975, at the Marriott Hotel in New Orleans, Louisiana. The meeting was chaired by Vice-President Charles Triplehorn in the absence of President Paul Ritcher. Vice-President Triplehorn welcomed members and called the meeting to order. For convenience, each topic discussed below is numbered consecutively.

1. A correction to the minutes of the 1974 meeting previously published by Ross Arnett was read by Secretary Gordon as follows: ("Arnett wrote that a problem has been in getting tax exempt status . . ."): "This has never been a problem. We have always had full tax exempt status as well as the ability to offer tax deduction status for any donation received. We are assured of this status as long as we exist. The true problem is simply that we must secure membership donations to offset large donations from individuals. A donation from the Coleopterists Society would have had to be offset by more membership donations in order for us to maintain the balance of income required by IRS. This fine point of the law is no doubt difficult to understand by the people attending a meeting unless considerable time is spent in the explanation. But the way it is reported in the Bulletin will cause a lot of unneeded correspondence on our part explaining to the nearly 1,200 individuals who have already donated that their tax deduction is still valid."

With this correction the minutes were accepted as published in the Coleopterists Bulletin, volume 29, March, 1975.

2. Secretary Gordon read into the minutes the changes in the Constitution aproved by the membership in 1974 but not read into the minutes of the 1974 meeting. These changes are as follows:

a) By-Law I. Section 6: Formerly read: "A member whose dues have not been paid within a reasonable period of time as determined by the Executive Committee will forfeit the privileges of membership. Such member may be reinstated upon payment of current dues." Now reads: ". . . .membership. Such members may be reinstated upon payment of dues owed during the period of delinquency plus the current dues."

b) Article II. Formerly read: "Object: The objective of the Society shall be to promote the study of Coleoptera." Now reads: "Object and Operation: The object of the Society shall be the advancement of the science of Coleopterology in all its aspects of theory, principles, methodology, and practice, for both living and fossil beetles, with emphasis on areas of common interest to all coleopterists regardless of individual specialization. With this object in mind, the Society shall be organized and operated exclusively for scientific and educational purposes."

c) By-Law V. Termination of the Society. Formerly read: "If, for any reason, the Coleopterists Society is terminated, the assets of the Society will be turned over to the Entomological Society of America." Now reads: ". . . .distributed to the 1) Society of Systematic Zoology, or 2) Entomological Society of America. However, if neither of the named recipients is then in existence, or if neither is then a qualified distributee, or if neither is willing or able to accept the distribution, then the assets of this organization shall be distributed to a fund, foundation, or corporation organized and operated exclusively for the purposes specified in section 501 (c) (3) of the Internal Revenue Code."

d) By-Law II. Section 1. Formerly read: "The officers and council of the Society shall serve as the Executive Committee. The immediate Past-President of the Society shall sit for one term as an ex-officio member of the Executive, and shall be entitled to vote." Now reads: "The officers, the council and the editor of the Coleopterists Bulletin, shall serve as the Executive Committee. The immediate Past-President of the Society shall sit for one term as an ex-officio member of the Executive, and shall be entitled to vote."

e) "By-Law VII. Journal. The journal of the Society shall be called the "Coleopterists Bulletin" and shall be conducted by an Editor, who shall be appointed by the President, with the approval of a majority of the Executive Committee."

3. Secretary Gordon read the items discussed at the Executive Committee meeting earlier in the afternoon as follows:

a. The hospitality hour to be held following the scientific session on December 1: a $2.00 donation was requested of all members attending to help defray expenses and the location of the affair disclosed.

b. Support for editor: The editor is to receive $500.00 per year for secretarial help; his expenses to attend the annual meetings of the Coleopterists Society will be paid by the Society if he does not have institutional funds for that purpose.

c. Dues Increase: The possibility of increasing dues was discussed and rejected because of a favorable treasurer's report on the financial status of the Society.

d. Coleopterists Newsletter: The reestablishment of the newsletter was discussed and 5 ways of handling it were proposed; as filler in the Bulletin without separation, as a separate section at the end of the Bulletin with separate pagination such as roman numerals, as a section without separate pagination, to simply drop the newsletter entirely, or to resume it in the original separate publication format.

During the following discussion Charles O'Brien pointed out that the matter had been discussed at the 1974 meeting and that a ballot was to have been sent out to the membership in 1975 for a vote on the matter. Secretary Gordon replied that such a ballot would be sent to the membership in 1976.

4. Officer's Reports.

a. Secretary Gordon. No Report.

b. Treasurer Erwin submitted the appended report which was audited by Oscar Cartwright, Don Anderson, and Gene Wood.

c. Editor's Report. Bob Woodruff, the outgoing editor, said that his report will appear in the December, 1975, issue of the Bulletin. Erwin proposed a special vote of thanks to Woodruff for producing a quality Bulletin at low cost and making the Bulletin what it is today. Vice-President Triplehorn concurred and remarked that Woodruff has done a first class job. Don Whitehead, the incoming editor, stated that his main purpose in attending the New Orleans meetings was to get feedback from the membership on editorial policy. Woodruff was asked about the backlog of manuscripts for the Bulletin. He said that the December, 1975, issue will be twice the normal size and that this will reduce the backlog to a 6-9 month waiting period.

5. Committee Reports.

a. Nomination and elections committee. Lee Herman, chairman of the committee, reported the election results. Tommy Allen is our new Vice President; new council members are J. Doyen, Hank Dybas, and Howard Frank.

b. Color Standards Committee. Committee reported that the ESA governing board is considering sponsoring the project.

c. O'Brien reported for Howard Frank on the Jamaica field trip. Twelve people were signed up to go, and Frank was in Jamaica awaiting their arrival. The total cost per person was estimated at about $250.00. [*A report is appended, p. 115*—ed.]

d. Cartwright's report on the audit of the treasurer's books was accepted by Triplehorn in Cartwright's absence.

6. Vice-President Triplehorn installed himself as the new President since former President Ritcher was not in attendance.

7. President Triplehorn asked George Ball to chair the nominating committee. Ball accepted and it was pointed out that the selections need to be made in time for inclusion in the March issue. [*A report is appended, p. 114*—ed.]

8. President Triplehorn pointed out that the 1976 meeting of the Coleopterists Society will be held in conjunction with the International Congress of Entomology rather than with the ESA annual meeting. The International Congress will be held in Washington, D. C., August 19-27, 1976.

9. President Triplehorn brought up the financing of the social hour and pointed out that it had been done by the officers in the past. Past President Ritcher contributed $50.00 toward it this year.

10. O'Brien brought up the subject of the Newsletter and suggested a rotating editorship. He said that the members should be allowed to vote on whether they wanted a Newsletter or not and motioned that a ballot be presented. Motion was seconded and discussion followed. Erwin said mechanisms for changing the format are included in the new constitutional amendments to be proposed. Lois O'Brien asked if a simple majority was required and it was agreed that it was. Motion passed.

11. Erwin mentioned that several proposed constitutional amendments will be submitted to the membership for vote in 1976 and that one of these amendments involves making the editor a voting member of the Executive Committee.

12. Ross Arnett talked on the North American beetle fauna project. He showed parts of publications completed and pointed out that parts 6-8 were still available, on weevils, chrysomelids, and cerambycids. The project now has a photocomposer available, and regional manuals will begin next year. Insect World Digest

has a membership of about 1275. Arrangements are almost completed for a firm to take over the fulfillment of that magazine. Arnett passed out examples of North American Beetle Project publication information sheets.

13. President Triplehorn adjourned the meeting and gave the location of the hospitality suite.

14. Other business.

A scientific session held the following evening was composed of talks by F. W. Stehr on "Progress of New Larval Text"; R. S. Beal, Jr., on "Values of Larval Studies for Taxonomy"; J. F. Lawrence on "The Use of Larval Characters in Solving Problems of Beetle Phylogeny". This was a joint session of the Immature Insect-Coleopterists Society.

Respectfully submitted,

Robert Gordon
Secretary (1975)

PROPOSED AMENDMENTS TO THE CONSTITUTION

ARTICLE V—*Officers*:

Present Wording

Section 1: The elective officers shall consist of the President who shall automatically and without election be the President-Elect from the outgoing Executive, the Vice-President who shall be President-Elect, the Secretary, Treasurer and six member Council.

Proposed Wording

Section 1: The officers of the Society shall be the President, President-Elect, Secretary, Treasurer, Managing Editor, and six member Council.

BYLAW II—*Officers*:

Present Wording

Section 4: The Vice-President shall assume the duties of the President in his absence at meetings, and shall become President in the event of death, resignation or disability of the President. In the event of absence of both President and Vice-President at a meeting, a temporary Chairman may be chosen to preside at that meeting by the members of the Executive Committee attending the meeting.

Proposed Wording

Section 4: The President-Elect shall be elected by the membership from those members who by their coleopterological achievements are considered to be among the leaders in the study of Coleoptera. The President-Elect shall take office at the close of the annual meeting following his election and shall serve until the close of the second annual meeting following his election when he shall succeed to the presidency. He shall be a voting member of the Council, ex officio, during his term of office, and shall perform the duties of President during any period when the President is unable to fulfill the duties of that office.

PRESENT WORDING

Section 7: Publication policy shall be a responsibility of the Executive Committee, which may appoint an editor or editors to implement this policy.

PROPOSED WORDING

Section 7a: The Society may in furtherance of its stated object, publish such journals, monographs, handbooks, or other publications as the Executive Committee may determine, within the needs and resources of the Society. A Managing Editor shall be elected according to the provisions of the Constitution and Bylaws.

Section 7b: The Journal of the Society shall be called "The Coleopterists Bulletin" and shall be conducted by a Managing Editor (directly responsible to the President and Council) and by any other editors that the Executive Committee may appoint. There shall be an Editorial Board, the members of which shall be appointed by the Managing Editor subject to approval by the Executive Committee for a term of three calendar years.

PRESENT WORDING

Section 8: Election of officers and council members shall be by mail-in ballot. The ballots shall be counted by three members appointed by the President. The nominees for each office shall be selected either by a nominating committee or may be nominated by any member in good standing. Write-ins on ballots will be permitted. Nominees must state, in writing to the Nominating Committee, their willingness to serve if elected.

PROPOSED WORDING

Section 8a: Nominations for President-Elect and Councillors shall be made by a Nominating Committee composed of the immediate Past-President (or if he is unable to serve, the next most recent Past-President) and two other members in good standing, who are not members of the Council, appointed by the President. The Past-President shall be Chairman of the Committee. This Committee shall give due consideration to equitable representation of the geographical distribution of the membership of the Society and of their interests in various aspects of Coleopterology. Nominations shall be announced in the first issue of The Coleopterists Bulletin. Additional nominations may be made by members under certain conditions (See Section 8c).

Section 8b: The Executive Committee shall nominate the Secretary, Treasurer, and Managing Editor. These nominees shall appear on the ballot and thereby be subject to membership approval.

Section 8c: Additional nominations for offices, except in the case of Secretary, Treasurer, and Managing Editor which are offices not subject to additional nominations, may be made by proposals signed by not less than five members of the Society in good standing, provided that such nominations are received by the Secretary at least 30 days in advance of the mailing of ballots. Such nominations from the membership shall be appropriately identified on the ballot mailed to members.

Section 8d: Election of officers and council members shall be by mail-in ballot. The ballots shall be counted by three members appointed by the President. Write-ins on ballots are not permitted. Nominees must state in writing to the Nominating Committee or Executive Committee, their willingness to serve if elected.

PRESENT WORDING

Section 9: The President or Vice-President may not succeed himself in that office; a council member may be renominated but may not serve for more than two consecutive terms.

PROPOSED WORDING

Section 9: The President or President-Elect may not succeed himself in that office; a council member may be renominated but may not serve for more than two consecutive terms. The Secretary, Treasurer, and Managing Editor shall serve at the discretion of the Executive Committee or until submitting their respective resignations.

PROPOSED PREAMBLE

PREAMBLE: Herein, the masculine pronouns shall constitute the feminine and the neuter, the singular, the plural, and vice versa.

BY-LAW I. Section 6.

A member whose dues have not been paid within a reasonable period of time as determined by the Executive Committee will forfeit the privileges of membership. Such members may be reinstated upon payment of dues owed during the period of delinquency plus the current dues.

ARTICLE II.

Object and Operation: The object of the Society shall be the advancement of the science of Coleopterology in all its aspects of theory, principles, methodology, and practice, for both living and fossil beetles, with emphasis on areas of common interest to all coleopterists regardless of individual specialization. With this object in mind, the Society shall be organized and operated exclusively for scientific and educational purposes.

BY-LAW V.

Termination of the Society: If, for any reason, the Coleopterists Society is terminated, the assets of the Society will be distributed to the 1) Society of Systematic Zoology, or 2) Entomological Society of America. However, if neither of the named recipients is then in existence, or if neither is then a qualified distributee, or if neither is willing or able to accept the distribution, then the assets of this organization shall be distributed to a fund, foundation, or corporation organized and operated exclusively for the purposes specified in section 501 (c) (3) of the Internal Revenue Code.

The purposes of these proposed amendments are to resolve certain ambiguities in wording of the present Constitution and to spell out more exactly how certain functions of the Society are to be carried out. The proposed amendments will be submitted to the membership for approval or disapproval by mail ballot prior to the next annual meeting.

* * *

EDITORIAL: NOTE TO CONTRIBUTORS AND READERS

I herewith take advantage of some unplanned inches of open space for some editorial comment. Probably, in due time, I shall submit a full-blown editorial; and probably, as with my illustrious predecessor, it will be my swan song. Here, I only hint of things to come and make some specific requests.

This issue, like the last, is unusually large; it does not herald a general change in publication policy, for these large issues are expensive. Thus, come June, we return to the previous norm. Printing costs are rising too, so it will be some months before we can determine our flexibility for increased pagination within the current dues structure.

In future issues I plan to experiment with format. Articles of general or continuing interest will be leaders; those of undeveloped data or of transient interest will appear either as filler or at the rear of the issue. I will also experiment with varying type sizes, using fine print for raw data (locality data, descriptions, lists). Reduced type size may mean no or little economic savings, but it should result in an aesthetically improved product.

For now, my specific editorial requests are the following. *Please send all contributions in at least duplicate, preferably triplicate.* Do likewise with illustrations, to minimize chance of loss in the mails or on someone's desk. Remember that manuscripts take repeated trips through the mail; that you need a copy, the printer needs one, and the editor needs one; and that the editor could use an extra—for rough editing and return to author for comment and repair. *Please have your paper read before submission, by at least 1 and preferably 2 competent, critical, outside authorities.* Save time; avoid embarrassment. An editor never quite catches up, and your paper may not get to be prepared for the printer until the last minute; if the author has already had his paper carefully reviewed, major surgery will be unlikely and the editor may even waive subsequent review. Taking this step also allows the author to properly acknowledge the reviewers. But remember—do not seek a friendly review, because as editor I will be forced to compensate in an unfriendly manner.

In the longer run, I hope to encourage increased quality, encouraging the more thoughtful contributions at the expense of those which lack useful synthesis. And, a wider diversity is desired: I want our Bulletin to embrace all aspects of beetle biology.

FINANCIAL STATEMENT (THROUGH NOVEMBER 26, 1975)

by Terry L. Erwin, audited by D. M. Anderson, O. L. Cartwright,
and F. E. Wood

Assets:	
Balance from 1974 (Nov. 26, 1974)	$10,574.91
Income: (November 25, 1974 to November 21, 1975)	
Page charges, separates, postage on separates charged to authors	2,696.61
Membership dues, subscriptions	5,765.08
Back issues	60.00
Interest on savings and certificate at Northern Virginia Savings and Loan	447.57
	$8,969.26
Balance of credits	$19,544.17

Disbursements:	
Printers cost of Bulletin Production (Sept., Dec. 1974; March, June, Sept. 1975)	$6,943.40
Addressograph service and envelopes	374.14
Inkblot Co. services and materials	217.35
Second class Mailing Permit/Editor's postage	191.00
ESA, 1974 Hospitality Suite	260.46
Service charges, Riggs Bank	21.09
Bounced checks	24.00
Copy Cat Printers (forms, preaddressed envelopes)	55.60
Secretary's Postage	75.00
Treasurer's supplies	2.05
	$8,164.09
Income over disbursements	$805.17
Total assets carried into 1976	$11,380.08

PROPOSED 1976 BUDGET

Income:	
Page charges	$2,500.00
Dues	3,830.00
Subscriptions	1,610.00
Interest on savings	600.00
	$8,540.00
Expenses:	
Bulletin Costs	$6,000.00
Printers other charges	500.00
Postage, envelopes, forms, etc.	200.00
Inkblot Co. services and materials	250.00
Editor's postage, Second class mail permit	350.00
1976 Hospitality Suite at XV Congress	300.00
Newsletter printing and postage	440.00
Editor's secretary	500.00
	$8,540.00

Respectfully submitted,

Terry L. Erwin
Treasurer (1975)

* * *

REPORT OF THE NOMINATING COMMITTEE

At the annual meeting held in New Orleans, November 30, 1975, I was invited by President C. A. Triplehorn to serve as Chairman of the Nominating Committee. In this capacity, I appointed Messrs. H. Goulet and J. S. Ashe to join the committee. At a meeting on December 30, held in the Strickland Museum, Department of Entomology, University of Alberta, we agreed on the slate of names presented below. Each nominee was contacted, and gave written consent to let his name stand.

SLATE OF OFFICERS FOR 1976-1977

For President-Elect:

Dr. Robert E. Woodruff, Bureau of Entomology, Division of Plant Industry, Florida Department of Agriculture and Consumer Service, Doyle Conner Building, P. O. Box 1269, Gainesville, Florida.

Dr. Frank N. Young, Department of Zoology, Indiana University, Bloomington, Indiana.

For Members of Council:

Dr. Harley P. Brown, Department of Zoology, The University of Oklahoma, 730 Van Vleet Oval, Room 222, Norman, Oklahoma.

Dr. Alfred F. Newton, Jr., Department of Entomology, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

Dr. Charles W. O'Brien, Laboratory of Aquatic Entomology, Florida Agricultural and Mechanical University, Tallahassee, Florida.

Dr. Stewart B. Peck, Department of Biology, Carleton University, Ottawa, Ontario.

Dr. J. Schuh, 4039 Shasta Way, Klamath Falls, Oregon.

Dr. Barry D. Valentine, Department of Zoology and Entomology, The Ohio State University, Columbus, Ohio.

Secretary:

Dr. Robert D. Gordon, USDA, Systematic Entomology Laboratory, c/o United States National Museum, Washington, D. C.

Treasurer:

Dr. Terry L. Erwin, Department of Entomology, Smithsonian Institution, United States National Museum, Washington, D. C.

Editor:

Dr. Donald R. Whitehead, c/o Department of Entomology, Smithsonian Institution, United States National Museum, Washington, D. C.

Respectfully submitted,

George E. Ball
Chairman

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THE COLEOPTERISTS SOCIETY, JAMAICA FIELD TRIP

By J. H. Frank, C. W. O'Brien, L. B. O'Brien, and G. B. Marshall

Twelve collectors went to Jamaica, 4-9 December 1975, following the annual Society meeting in New Orleans. Howard Frank made the arrangements, and met us at the airport. After the formalities of customs, car rentals, and dinner in Kingston, the 3-car caravan slowly went up into the Blue Mountains in a pouring rain to a forestry camp at Clydesdale, arriving at 2 A.M. Despite the late arrival, everyone was up early; and after breakfast and some planning, we all went collecting in the rain. For 2 days and nights the rain persisted, but so did we; and evenings around the fire were very pleasant and all too short as we talked about beetles and collecting.

Clydesdale is a nursery and is planted mainly with pines and other introduced trees, so collecting there was somewhat limited. Therefore, we drove out or walked the mountain trails to find better natural habitats. Hardwar Gap was a favorite for all, but especially for the weevil collectors. Fresh-cut trails and areas for picnic shelters were attracting many weevils and other beetles. After 2 days of cold, wet weather, several of us went to the lowlands for a day in the sun. The Hellshire Hills near Kingston, an area of native thorn scrub and cactus (e.g., prickly pear, acacia, and mesquite), were rich in insects. That night in the mountains and the next day and night were dry, and collecting there improved accordingly. On the last day of collecting, one car went down to the north coast and the others revisited several areas.

Though some people had disappointing collecting, everyone had a fine time and considered the trip a great success. Wet conditions and the lack of sun reduced our success with berlese funnels. Without sun for heat, some of the berleses could not be used, and the wet litter did not allow good penetration of the tear gas used by others. We found the forestry camp arrangement excellent for collecting, though the Hardwar Gap area would probably be better as it is still natural. There is no electricity at the camp and we all were surprised at how little light one gets from candles and kerosene lamps. We all now have a deeper respect for Abraham Lincoln and others who studied by candle light. We were pleased with facilities at Clydesdale and were pleasantly surprised to learn that the shower had hot water. The kerosene refrigerator worked fine once filled and lit. Meals were cooked on the 2-burner gas stove; our 3 lady cooks earned the special thanks of everyone present for producing fabulous food with limited facilities, unfamiliar vegetables and recipes, and few spices. (Thanks also to Audrey Frank for menu suggestions using local commodities.) Food was more expensive than expected, about as in the U.S. Gasoline was very high, about $1.25/ gallon. Fees for use of the camp were low, about $.30 each/ day. Overall costs for the trip were really quite low (food, lodging, and car rental, $62.60/ person).

Should anyone wish to rent either the facilities at Clydesdale or a cabin at Hardwar Gap, contact the Director of Forestry, Forest Department, 144 Constant Spring Road, Kingston, Jamaica, W.I.

Dr. Thomas Farr of the Science Museum of the Institute of Jamaica joined us for one day and night and gave us invaluable information on collecting sites and local botany. He recommends June, July, and August for peak beetle collecting.

Participants were George and Kay Ball, Henry and Milada Dybas, Wills Flowers, Howard Frank, Gary Hevel, Benn Marshall, Charles and Lois O'Brien, Elbert Sleeper, and Eric Yensen.

U. S. POSTAL SERVICE

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

(Act of August 12, 1970: Section 3685. Title 39. United States Code

1. TITLE OF PUBLICATION
The Coleopterists Bulletin

2. DATE OF FILING
Oct. 9, 1975

3. FREQUENCY OF ISSUE
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3A. ANNUAL SUBSCRIPTION PRICE

4. LOCATION OF KNOWN OFFICE OF PUBLICATION *(Street, city, county, state and ZIP code) (Not printers)*
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c/o Dr. R. E. Woodruff, Box 1269, Gainesville, FL 32602

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The Coleopterists Society (no permanent address)

EDITOR *(Name and address)*
Dr. R. E. Woodruff, Box 1269, Gainesville, FL 32602

MANAGING EDITOR *(Name and address)*
same

7. OWNER *(If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.)*

NAME	ADDRESS
The Coleopterists Society	c/o Dr. R. E. Woodruff, Box 1269, Gainesville, FL 32602

8. KNOWN BONDHOLDERS, MORTGAGEES, AND OTHER SECURITY HOLDERS OWNING OR HOLDING 1 PERCENT OR MORE OF TOTAL AMOUNT OF BONDS, MORTGAGES OR OTHER SECURITIES *(If there are none, so state)*

NAME	ADDRESS
None	

9. FOR OPTIONAL COMPLETION BY PUBLISHERS MAILING AT THE REGULAR RATES *(Section 132.121, Postal Service Manual)*

39 U. S. C. 3626 provides in pertinent part: "No person who would have been entitled to mail matter under former section 4359 of this title shall mail such matter at the rates provided under this subsection unless he files annually with the Postal Service a written request for permission to mail matter at such rates."

In accordance with the provisions of this statute, I hereby request permission to mail the publication named in Item 1 at the reduced postage rates presently authorized by 39 U. S. C. 3626.

(Signature and title of editor, publisher, business manager, or owner)

10. FOR COMPLETION BY NONPROFIT ORGANIZATIONS AUTHORIZED TO MAIL AT SPECIAL RATES *(Section 132.122 Postal Service Manual) (Check one)*

The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes

☒ Have not changed during preceding 12 months

☐ Have changed during preceding 12 months

(If changed, publisher must submit explanation of change with this statement.)

11. EXTENT AND NATURE OF CIRCULATION	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS	ACTUAL NUMBER OF COPIES OF SINGLE ISSUE PUBLISHED NEAREST TO FILING DATE
A. TOTAL NO. COPIES PRINTED *(Net Press Run)*	700	700
B. PAID CIRCULATION 1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES		
2. MAIL SUBSCRIPTIONS	623	640
C. TOTAL PAID CIRCULATION	622	639
D. FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS SAMPLES, COMPLIMENTARY, AND OTHER FREE COPIES	1	1
E. TOTAL DISTRIBUTION *(Sum of C and D)*	623	640
F. COPIES NOT DISTRIBUTED 1. OFFICE USE, LEFT-OVER, UNACCOUNTED, SPOILED AFTER PRINTING	77	60
2. RETURNS FROM NEWS AGENTS		
G. TOTAL *(Sum of E & F—should equal net press run shown in A)*	700	700

I certify that the statements made by me above are correct and complete.

SIGNATURE OF EDITOR, PUBLISHER, BUSINESS MANAGER, OR OWNER
Robert E Woodruff

(*Continued from inside front cover*)

departments, provinces, parishes, and/or counties listed. Dates are listed by day, month (in Roman numerals), and last 2 digits of the year. Listing of ecological data is encouraged. Location of specimens should be shown in brackets; if the data is extensive these should be abbreviated as shown and the abbreviations listed in the text.

Any article concerning Coleoptera will be considered. Descriptions of new taxa must contain keys (or be correlated with existing keys) and illustrations. All manuscripts should be typed on 8½×11" opaque white paper with 1 inch margins. They should be typed on one side only and double spaced throughout (including title, footnotes, tables, figure legends, and references). All scientific names should be underlined. Use the following order: title, author, author's address, abstract, body of text, references cited, and figures. All footnotes, tables, and figure legends should be provided on separate sheets and double spaced. Indicate approximate figure and table locations in pencil in the margin of the manuscript.

An abstract should be a concise statement of the facts presented, not *that* they are presented (e.g. list names of organisms, not just that they were discussed or described as new). These abstracts are the key to how your article will be cited in the abstracting journals and should be carefully written.

THE COLEOPTERISTS SOCIETY

OFFICERS FOR THE SOCIETY 1976

President: C. A. Triplehorn, Dept. Ent., Ohio State Univ., Columbus, OH 43201.
President-Elect: R. T. Allen, Dept. Ent., Univ. Arkansas, Fayetteville, AR 72701.
Secretary: R. D. Gordon, Syst. Ent. Lab., USDA, ARS, c/o U. S. National Museum, Washington, D. C. 20560.
Treasurer: T. L. Erwin, Div. Coleoptera, Dept. Ent., U. S. National Museum, Washington, D. C. 20560.
Editor (Coleopterists Bulletin): D. R. Whitehead, c/o Dept. Ent., U. S. National Museum, Washington, D. C. 20560.

COUNCIL THROUGH 1976

F. N. Young, Dept. Zool., Indiana Univ., Bloomington, IN 47405.
F. G. Werner, Dept. Ent., Univ. Arizona, Tucson, AZ 85721.
D. R. Whitehead, c/o Dept. Ent., U. S. Nat. Mus., Washington, DC 20560.

COUNCIL THROUGH 1977

J. T. Doyen, Div. Ent. & Parasit., Univ. California, Berkeley, CA 94720.
H. S. Dybas, Dept. Ent., Field Museum, Chicago, IL 60605.
J. H. Frank, Florida Med. Ent. Lab., P. O. Box 520, Vero Beach, FL 32960.

NOTICES

Notices to appear on this page are a free service to members and subscribers. Such copy will be limited to the back page, the older notices being moved up and replaced with the newest ones at the bottom. The editor reserves the right to reword such notices for brevity, consistency, and clarity.

FREE PUBLICATION: If you are not now receiving "Progress Reports", the newsletter of the North American Beetle Fauna Project, send your name, address, and interest in beetles statement to: Dr. R. H. Arnett, NABF Project, Dept. Biol., Siena College, Loudonville, NY 12211.

PSEPHENIDAE (including EUBRIINAE, EUBRIANACINAE, and PSEPHENINAE): Revising the family in the Western Hemisphere. Request loan of any material from the New World. Dr. Harley P. Brown, Zoology Dept., Univ. of Oklahoma, 730 Van Vleet Oval, Norman, Oklahoma 73069.

EXCHANGE: Curculionidae, Buprestidae, and Carabidae. Massimo Heregalli, C. A. Picco 27, 10131 Torino, ITALY.

CICINDELIDAE: Need specimens of following genera for morphological studies of family: ***Eucallia, Nickerlea, Rhysopleura, Langea, Opisthencentrus, Iresia, Oxygonia, Ctenostoma, Pogonostoma, Caledonomorpha, Caledonica, Distipsidera, Aniara, Prothyma.*** Wish to exchange, borrow, or purchase and can use poorly labelled or damaged material. R. D. Ward, Dept. Ent., Michigan State Univ., East Lansing, Mich. 48823.

FOR SALE: Exotic beetles from Malaysia, New Guinea, Africa, Brazil, etc. Send $1.00 for 64 p. catalogue. Prospect Biological, P. O. Box 307, Round Lake, Illinois 60073.

PHILIPPINE BEETLES: Leonard L. Lengyel, c/o Mrs. Manuela R. Ablan, Rizal St., Laoag City, Ilocos Norte, Rep. Philippines.

LITERATURE DESIRED: Donations of reprints, journals, and reference works are solicited to build up library. Wau Ecology Institute, Box 77, Wau, PAPUA, NEW GUINEA.

SCARABAEIDAE: Want to purchase ***Dynastes tityus*** and ***Plusiotus*** from North and Central America or trade for ***Psalidognathus superbus*** and French Scarabaeidae. T. D. Haas, 97 Barnes St., Long Beach, N. Y. 11561.

BUPRESTIDAE: Buy, exchange, determine Central American Agrilinae for revisionary studies. Henry A. Hespenheide, Dept. Biology, Univ. California, Los Angeles, California 90024.

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CARABIDAE: Have *Calosoma (Carabominus) asper* Jeannel & *C. (Blapstoma) chihuahua* Gidaspow for exchange. I want *Carabus,* Cychrini, or *Calosoma* not represented in my collection. B. Rotger, Pagosa Springs, Colo. 81147.

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THE COLEOPTERISTS BULLETIN

AN INTERNATIONAL JOURNAL DEVOTED TO THE STUDY OF BEETLES

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JUNE, 1976

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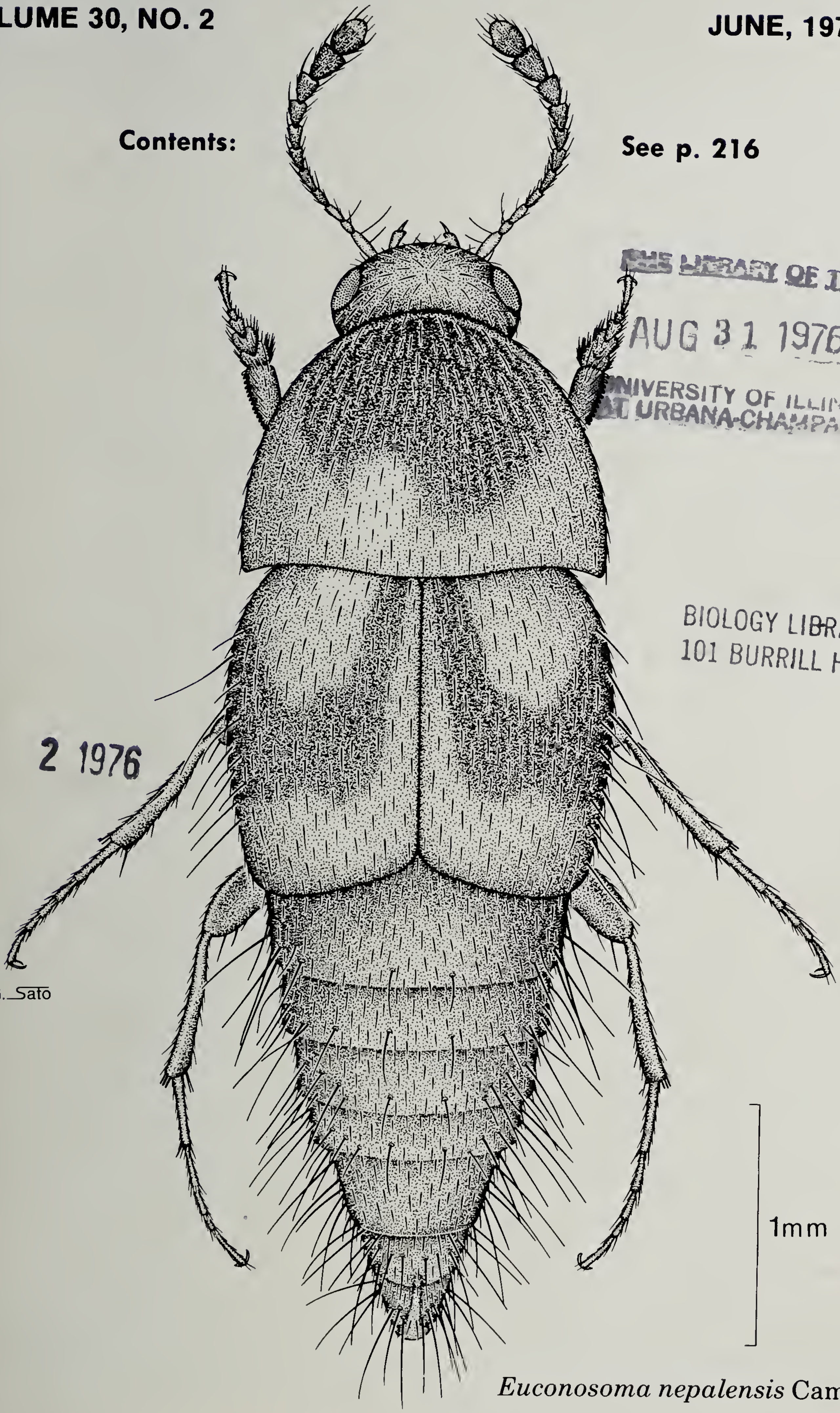

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The following exceptions are noted: 1) all geographical names are to be spelled out, 2) use words, not symbols, for male and female, 3) use numerals throughout, except to begin a sentence, 4) entomology, -ical, -ist, etc. are to be abbreviated Ent. in literature citations.

Specimen label data should be listed in the following manner: MEXICO: State of Veracruz, Fortin de las Flores, 10-VIII-70, I. B. Jones, under bark of **Pinus moctezumae**, 7000ft. [USNM] (2). The number in parentheses indicates the number of specimens. Geographical names are listed in order with largest units first, with states,

(*Continued inside back cover*)

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GEOGRAPHICAL VARIATION IN *PACHYBRACHIS NIGRICORNIS* (COLEOPTERA: CHRYSOMELIDAE)

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Biological Sciences, South Dakota State University, Brookings, SD 57006

Abstract

A taxonomic revision indicates that *Pachybrachis nigricornis* (Say) is a polymorphic species (morphologically as well as chromatically). This species includes 3 polytopic subspecies, *P. n. nigricornis, P. n. difficilis* Fall, and *P. n. autolycus* Fall; and one monotopic subspecies, *P. n. carbonarius* Fall. The subspecies differ most notably by color characters. Stepwise discriminant analysis indicates that the subspecies are taxonomically distinct when segregated by a character index. Pigmentation in *P. n. autolycus* is light and its distribution corresponds with dry climates, which facts agree with those of *P. othonus sioux* Balsbaugh, a sibling species of *P. n. autolycus. P. n. nigricornis* is dark and shiny, but it too occurs in arid areas. Fall's Group D key to vittate species has been modified to reflect the new nomenclature changes and to include the black subspecies of *P. nigricornis.*

When analyzing geographic variation in the polymorphic species *Pachybrachis othonus* (Say), Balsbaugh (1973) discovered the existence of sibling species, i.e. "morphologically similar or identical natural populations that are reproductively isolated" (Mayr 1971), in *P. o. sioux* Balsbaugh and what at that time was known as *P. autolycus* Fall. Such a phenomenon had been recognized earlier in lady beetles by Dobzhansky (1933) who stated that, "Homologous varieties of different species may be more similar to each other in appearance than the different varieties of the same species." In addition to the many other examples of animal sibling species that Mayr (1965) has cited, Vavilov (1922) also recognized that large groups of related plant species and genera often exhibit parallel series of homologous patterns.

The discovery that *P. o. sioux* and *P. autolycus* were sibling species led us to conduct further studies on infraspecific-geographic variation in the latter species. Names for the color forms in the *autolycus*-complex include: *P. nigricornis* (Say, 1823); *P. carbonarius* Haldeman, (1849); *P. carbonarius* var. *janus* Fall, (1915); *P. autolycus* Fall, (1915); *P. autolycus* var. *difficilis* Fall, (1915); and *P. autolycus* var. *wahsatchensis* Fall, (1915).

Methods

For an indication of conspecificity, male genitalia of several specimens of all color forms were dissected and compared (Figs. 1-5).

For an indication of taxonomic distinction and to evaluate geographic variation, 10 characters were used and coded in character states as follows:

1) Pronotal surface texture: (1) specimens with pronotal surface strongly alutaceous and (2) beetles with pronotal surface smooth or only slightly alutaceous.

2) Pronotal punctation density: (1) dense punctation and (2) less dense punctation.

3) Size of pronotal punctures: (1) pronotal punctures much less coarse than elytral punctures and (2) punctures nearly as coarse as elytral punctures.

4) Pronotal coloration: (1) totally black pronotum, (2) pronotum black but with anterior edges lighter, (3) pronotum with paired basal and medial anterior spots, and (4) pronotum with large yellow areas and a distinct black M-shaped mark.

5) Elytral coloration: (1) totally black, (2) black with reddish yellow lateral edges, (3) with sutural and interrupted mid-elytral vittae, and (4) with yellow stripes as wide or wider than black stripes.

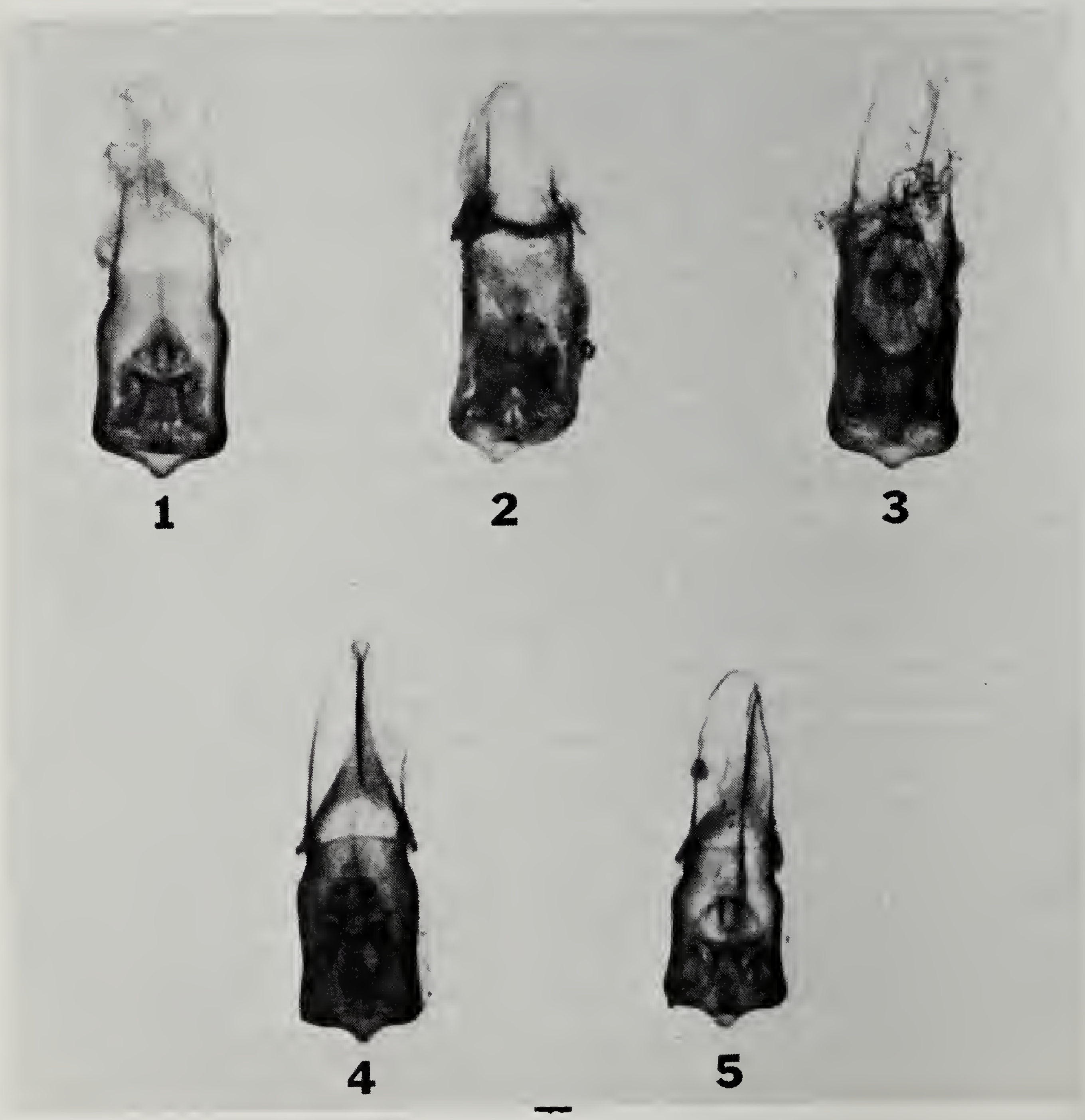

Fig. 1-5. Dorsal views of aedeagi: 1) *Pachybrachis nigricornis nigricornis* (Say); 2) *P. n. carbonarius* Haldeman; 3) *P. n. difficilis* Fall, formerly var. *difficilis*; 4) *P. n. difficilis* Fall, formerly var. *wahsatchensis* Fall; 5) *P. n. autolycus* Fall.

6) Pygidial coloration: (1) all black, (2) black with paired yellow spots, and (3) apical area entirely yellow.

7) Character index: a character index for each specimen was comprised of the sum of the values of the 6 preceding characters.

8) Elytral width: maximum width across both elytra.

9) Elytral length: length from front edge of elytron at humerus to posterior edge of elytron at apex, in a line parallel to the elytral suture.

10) Elytral ratio: elytral width/elytral length.

Measurements were made with an ocular grid. A total of 865 specimens was used in this study. All of the above character values were used in a stepwise discriminant analysis.

Correlation of characters with distribution was attempted. Based on experience with *P. othonus* (Balsbaugh 1973), political states were assigned code numbers, one per state for those states east of the 100th meridian. States through which the 100th meridian passes and the mountain states immediately to the west of them were subdivided into 2 or 3 areas, because greater variation was expected in these areas.

SYNONYMY AND DIAGNOSES

Pachybrachis nigricornis nigricornis (Say)
(Fig. 1, 6, 7)

Cryptocephalus nigricornis Say, 1823, Journ. Acad. Nat. Sci. Philadelphia 3:436-437. (Neotype, Fig. 6).

Pachybrachis carbonarius var. *janus* Fall, 1915. Trans. Amer. Ent. Soc. 41:462-463. (Holotype, Fig. 7). **New synonymy.**

P. n. nigricornis is distributed chiefly in the Great Plains states and provinces (Fig. 12). Say (1823) listed the type locality as "Missouri", which meant the Missouri Territory and included areas west to the Rockies. It is not found in the present state of Missouri; rather its range is continuous in Nebraska, South Dakota, North Dakota, and Saskatchewan, with discontinuous pockets in Oregon, Washington, Idaho, Alberta, Colorado, Kansas, and Arkansas.

Inasmuch as Weiss and Ziegler (1931) indicated that Say's collection, including his American types, had been destroyed, we are designating a neotype for *P. nigricornis* in order to synonymize the name with certainty with Fall's *P. carbonarius* var. *janus*. Based on current knowledge of distribution of *P. nigricornis,* there are 3 areas where Say traveled in 1820 from which he may have collected specimens of this species: In Nebraska, along the westward route of the Long Expedition up the Platte River; in Colorado near Long's Peak; and in Arkansas along the Arkansas River, the eastward route of the Expedition. We have selected the neotype from Boulder, Colorado, an area very near to, if not on the actual route of the Long Expedition. On June 30, 1820, for the first time, the Long Expedition saw Long's Peak which is near Boulder (Weiss and Ziegler, 1931, p. 77).

We are proposing the new synonymy of *P. n. nigricornis* (Say) and *P. carbonarius* var. *janus* Fall, based on comparison of our neotype for the former with Fall's holotype of var. *janus*. Fall (1915, p. 462-463) was just as uncertain as to how to treat this color form as he was the 2 varieties of

P. autolycus that he also described, viz. *difficilis* and *wahsatchensis*. Concerning var. *janus,* he stated: "This form lies exactly between typical *carbonarius* and *nigricornis* and merges into both so gradually that I am as yet completely unable to draw the dividing lines."

The following description is based on the neotype of *Cryptocephalus nigricornis* Say; see also Say (1823).

Description: Body 1.35 times as long as wide; widest at humeri, sides more or less parallel but slightly concave just behind the humeri and tapered in gradual arch at posterior end; black, dorsal surface shiny, without pubescence, pygidium and venter with dense short whitish pubescence.

Head: Black, alutaceous; frons densely punctate with short seta in each puncture; vertex more sparsely and less coarsely punctate, punctures not setose; labrum rufous; eyes (female) separated by 0.6 times distance from labral suture to occiput. Antennae black, except basal 4 joints rufous on venter, length, 1/2 length of body.

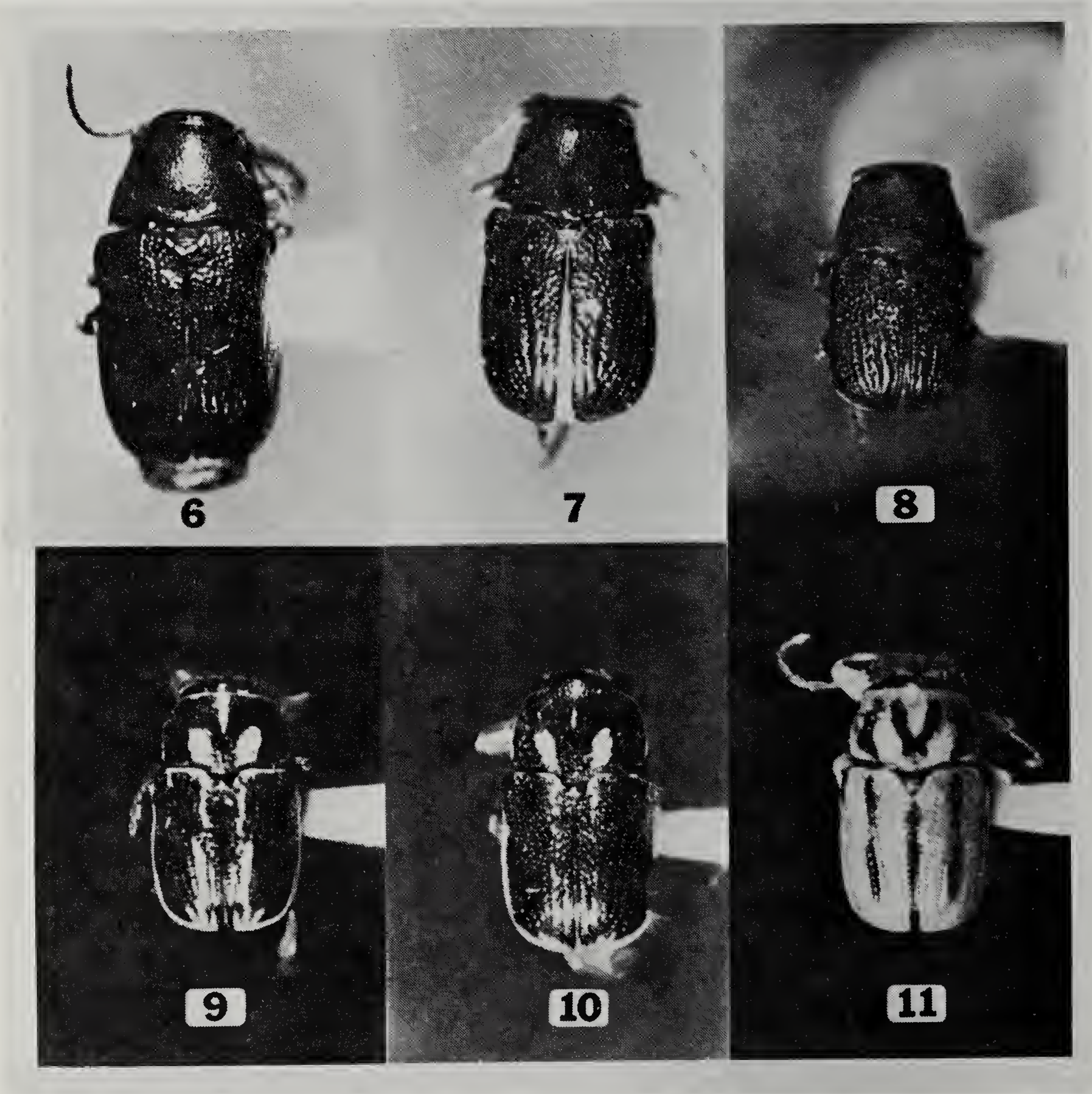

Fig. 6-11. 6) Neotype, *Cryptocephalus nigricornis* (Say) (=*P. n. nigricornis* (Say)); 7) Holotype, *P. carbonarius* var. *janus* Fall (=*P. n. nigricornis* (Say)); 8) Holotype, *P. carbonarius* Haldeman (=*P. n. carbonarius* Haldeman); 9) Holotype, *P. autolycus* var. *difficilis* Fall (=*P. n. difficilis* Fall); 10) Holotype, *P. a.* var. *wahsatchensis* Fall (=*P. n. difficilis* Fall); 11) Holotype, *P. autolycus* Fall (=*P. n. autolycus* Fall).

Pronotum: Black, shiny, but slightly alutaceous (more distinctly so than elytra); densely punctate. Lateral margins rufous but marginal bead black.

Scutellum: Black.

Elytra: Black, shiny, punctate, punctures in nearly regular striae; interstriae somewhat costate. Lateral margins, basal bead, and apex obsoletely rufous.

Ventral Surface: Black, densely setigerously punctate. Fifth abdominal sternite (female) with medial fovea. Legs black, except knees, tibiae and tarsi slightly rufous.

Length: 3.8 mm.

Type data: The neotype is a female. [Original probably was a female. Say gave its size as "less than three-twentieths of an inch" (=3.81 mm).] Type locality: "Boulder, Colo. 5800′, June 5, 1961, B. H. Poole." The neotype is deposited in the Canadian National Collection, Entomology Research Institute, Ottawa, Canada.

Pachybrachis nigricornis carbonarius Haldeman
(Fig. 2, 8)

Pachybrachis carbonarius Haldeman, 1849, Journ. Acad. Nat. Sci. Philadelphia, Ser. 2, 1:260. (Holotype, Fig. 8)

P. n. carbonarius is distributed in the eastern half of North America (Fig. 12) west to Manitoba, the extreme eastern parts of the Dakotas, and south to eastern Texas. Southern Ontario and the Great Lakes are the northern boundaries and it extends south to central Mississippi, Alabama, Georgia, and Florida. Haldeman (1849) gave the type locality as "Southern".

Description: Body 1.69-1.80 times as long as wide; widest at humeri, sides more or less parallel; black or dark brownish black, dorsal surface dull, not shiny, without pubescence, pygidium and venter with dense short whitish pubescence.

Head: Black, alutaceous, frons densely punctate with short seta in each puncture; vertex more sparsely and less coarsely punctate, punctures not setose; labrum rufous. Antennae black, basal joints rufous on venter, 1/2 length of body in female, about 3/4 length of body in male.

Pronotum: Black, alutaceous, dull; densely punctate; occasionally lateral margins rufous.

Scutellum: Black.

Elytra: Black or brownish black, usually lighter in color than the pronotum. Punctate in nearly regular rows; interstriae somewhat costate. Punctures larger than those of pronotum.

Ventral Surface: Black, densely setigerously punctate. Fifth abdominal sternite of female foveate. Legs black, except knees, tibiae, and tarsi slightly rufous.

Length: 2.4-3.6 mm.

Hosts: Series of specimens have been taken on wild strawberry and *Desmodium,* and a single specimen was recorded taken on *Quercus* sp.

Pachybrachis nigricornis difficilis Fall
(Fig. 3, 4, 9, 10)

Pachybrachys autolycus var. *difficilis* Fall, 1915, Trans. American Ent. Soc. 41:459. (Holotype, Fig. 9).

Pachybrachys autolycus var. *wahsatchensis* Fall, 1915, Ibid. 41:459-460. (Holotype, Fig. 10). **New synonymy.**

Distribution of this subspecies is very odd (Fig. 12). It occurs primarily in western North America and so far as current collection samples indicate it is found in disjunct populations in Oklahoma, Texas, New Mexico, Arizona, Colorado, Utah, Wyoming, Montana, Idaho, Oregon, Washington, British Columbia, Alberta, Saskatchewan, and Manitoba. It also is found in eastern North America. Fall (1915) recorded Tyngsboro, Massachusetts, as type locality for *P. a. difficilis*. It occurs in northern New York, Quebec, eastern Ontario, and the northern-most areas of the south peninsula of Michigan.

New synonymy has been proposed after comparison of Fall's holotypes. Fall (1915), when describing the varieties *difficilis* and *wahsatchensis*, mentioned their close relationship, indicating that they differ primarily through the absence of intrahumeral yellow spots in *wahsatchensis*. He also stated that "it is far from unlikely that both *wahsatchensis* and *difficilis* are the more usual forms of the rare *nigricornis*." Had Fall compared the aedeagi (Figs. 1, 3, 4) he probably would have concluded that these forms are conspecific.

By way of clarification, we have observed an error or a mixup in labels attached to 2 paratypes of *P. a. difficilis* belonging to the U. S. National Museum. Two paratypes of *difficilis* from "Ashfork, Ar." were labeled as paratypes of "*autolycus* var. *wahsatchensis* Fall." These are probably those specimens of *difficilis* collected by Barber and Schwartz, mentioned in Fall's (1915) revision. We have left these 2 specimens with the errors, as we found them, but have added our own determination labels.

Description: Body 1.76-1.88 times as long as wide; widest at humeri (males) or at mid area of elytral length (females); elytra black with yellow vittate interruptions, varying from nearly completely black with submarginal and subsutural vittae to black with submarginal, subsutural and mid-elytral yellow vittae; dorsal surface shining; pygidium and venter with dense short whitish pubescence.

Head: Black, with yellow areas mesad of both upper and lower ocular lobes and on clypeus; frons densely punctate with short seta in each puncture; vertex more sparsely and less coarsely punctate, these punctures not setose; labrum yellow. Antennae black, basal joints rufous on venter, 1/2 length of body in females, about 3/4 length of body in males.

Pronotum: Black, with mid apical, paired basal, anterior and lateral margins yellow; shining, densely punctate.

Scutellum: Black.

Elytra: (See general description).

Ventral Surface: Black, densely setigerously punctate. Fifth abdominal sternite of female foveate. Legs black except yellow spots on apical ends of mid and hind femora.

Length: 2.8-3.8 mm.

Hosts: Host plants have not been recorded for this subspecies.

Pachybrachis nigricornis autolycus Fall
(Fig. 5, 11)

Pachybrachys autolycus Fall, 1915, Trans. American Ent. Soc. 41:458-459. (Holotype, Fig. 11).

P. n. autolycus is a subspecies occupying a dry habitat (Fig. 12). It occurs more or less continuously in Kansas, Oklahoma, and northeastern Texas, with smaller disjunct populations or individuals in Arkansas, Missouri, Iowa, southwestern Illinois, North Dakota, South Dakota, Alberta, Nebraska, New Mexico, Arizona, and Colorado.

Fall (1915 p. 460) indicated that *autolycus* " . . . approaches *othonus*" (*sensu stricto*) and Balsbaugh (1973) demonstrated that it and *P. o. sioux* Balsbaugh were sibling species.

Description: Body 1.75-1.85 times as long as wide; widest at humeri (males) or at mid area of elytral length (females); elytra yellow with the suture and 2 vittae per elytron black; lateral-most vitta frequently interrupted; dorsal surface shiny to dull alutaceous; pygidium and venter with dense short whitish pubescence.

Head: Black with yellow areas on clypeus and mesad of eyes, usually more yellow than *P. n. difficilis*; frons densely punctate with a short seta in the punctures; vertex more sparsely and less coarsely punctate, these punctures not setose; labrum yellow. Antennae brown, basal joints lighter, 1/2 length of body in female and about 3/4 length of body in male.

Pronotum: Yellow with distinct black M-shaped mark, varying to minutely alutaceous, densely punctate in black areas.

Scutellum: Black.

Elytra: (See general description).

Ventral Surface: Black, fifth abdominal sternite margined apically with yellow, fifth abdominal sternite of female with medial fovea. Legs yellow, apexes of hind tibiae darker. Pygidium black basally, with paired contiguous yellow apical spots and a pair of smaller lateral ones.

Length: 2.6-3.8 mm.

Hosts: A collection by M. W. Sanderson of a large series on *Desmodium* at Valmeyer, Illinois, May 24, 1950, very nicely reinforces our belief in the conspecificity of *P. n. autolycus* and *P. n. carbonarius* on biological grounds, as well as morphologic. This plant was reported as a host for *P. n. carbonarius* by an unknown collector, in Crawford Co., Arkansas.

KEY TO SUBSPECIES OF *P. nigricornis* AND THEIR CLOSE RELATIVES

Fall (1915) presented a key to 159 species of *Pachybrachis* by recognizing groups of species based chiefly on coloration. It is now quite evident that such groupings pose great problems for identifiers since polymorphic species have been demonstrated (Balsbaugh, 1973). A new key to all species of North American *Pachybrachis* is needed, but such must await further analyses by species-groups, such as that done in this paper. Nevertheless, we present the following key, modified from Fall's Group D key, which encompasses chiefly vittate forms, but also now the black subspecies of *P. nigricornis*.

1. Punctation of elytra very irregular ("confused") 2

1′. Punctation of elytra arranged in nearly regular series (less conspicuously so in *P. picturatus*) 6

2(1). Terminal spurs of front tibia wanting or rudimentary; last segment of maxillary palpus scarcely differing between sexes; punctation coarser and denser; southern and southeastern United States .... *P. viduatus* (Fab.)

2′. Terminal spur of front tibia normally developed; last segment of maxillary palpus more widely truncate in male; punctation finer and less dense 3

3(2′). Eyes in male separated by distance evidently less than twice length of basal antennal segment; elytra bivittate, outer stripe rarely if ever continuous, interrupted or not, in form of 1, 2 or 3 spots .... *P. bivittatus* (Say)
3′. Eyes in male separated by distance at least twice length of basal antennal segment 4

4(3′). Elytra of some specimens with single narrow vitta, with or without faint traces of lateral spots, but usually destitute of markings; submarginal stria very irregular; eyes in male separated by twice length of basal antennal segment, or little more. California .... *P. sublimatus* Fall
4′. Elytra each with single broad discal vitta; eyes separated by 2.50 to 3.00 times length of basal antennal joint 5

5(4′). Eyes in female less widely separated than by their own vertical length; submarginal stria nearly regular. California and Oregon .... *P. circumcinctus* Crotch
5′. Eyes in female more widely separated than by their own vertical length; submarginal stria more irregular. California .... *P. consimilis* Fall
6(1′). Prothorax densely punctate, punctures more or less strigose, especially laterally; with smooth median line extended posteriorly from anterior margin, but not reaching basal margin 7
6′. Prothorax punctate, but punctures less dense, not strigose; anterior medial line of various widths, or absent 9

7(6). Elytra vittate 8
7′. Elytra not vittate; yellow with sutural bead, humeri and punctures black .... *P. othonus pallidipennis* Suffrian

8(7). Pronotum with pair of yellow spots at base, one on either side of medial line .... *P. othonus sioux* Balsbaugh
8′. Pronotum without basal spots .... *P. o. othonus* (Say)

9(6′). Elytra entirely black, or black with narrow subsutural vitta, and sometimes with lateral and apical margins yellow 10
9′. Elytra with predominating ground color yellow 12

10(9). Elytra entirely black or dark brown 11
10′. Elytra black with narrow subsutural vittae, intrahumeral basal spots, or lateral and apical margins yellow .... *P. nigricornis difficilis* Fall

11(10). Pronotum densely punctate, alutaceous; usually blacker in color than elytra .... *P. nigricornis carbonarius* (Haldeman)
11′. Pronotum less densely punctate, shining to minutely alutaceous; usually of same color as elytra .... *P. n. nigricornis* (Say)

12(9′). Elytron yellow with single discal black vitta 13
12′. Elytron yellow with suture or sutural bead and 2 discal vittae on each black or brownish 14

13(12). Elytra yellow with single narrow, often imperfect or subobsolete, median black vitta; and humeri and posterior spot black; New Mexico, Arizona .... *P. umbraculatus* Suffrian
13′. Elytra yellow with single straight sharply defined but narrow black vitta and black humeri. North and South Carolina .... *P. picturatus* Germar

14(12′). Front claws of male not enlarged 15
14′. Front claws of male distinctly enlarged; lustre dull, outer elytral vitta confined to 7th and 8th interspaces........ *P. pawnee* Fall

15(14). Surface sculpture of head and pronotum more or less alutaceous (very fine and visible only on head and towards sides of pronotum in some examples of *P. nigricornis autolycus*)........ 16
15′. Integument polished; alutaceous sculpture not present except occasionally very faintly on head 17

16(15). Pronotum strongly transverse, more closely punctate........ *P. nigricornis autolycus* Fall
16′. Pronotum moderately transverse, more sparsely punctate; always distinctly alutaceous. Florida, Georgia, South Carolina, North Carolina, District of Columbia and New Jersey .... *P. litigiosus* Suffrian

17(15′). Outer elytral vitta beginning on 7th and 8th interspaces, and ending on 6th and 7th 18
17′. Outer elytral vitta confined to 7th and 8th interspaces; median pronotal stripe conspicuously V-shaped 19

18(17). Median pronotal stripe narrowly V-shaped; size smaller (2.7-3.8 mm). Texas, Kansas........ *P. dubiosus* LeConte
18′. Median pronotal stripe not V-shaped but merely dilated slightly anteriorly, dilated portion usually with very narrow more or less obscure paler line; size larger (3.7-4.4 mm). Nebraska, Kansas, Texas, Colorado........ *P. virgatus* LeConte

19(17′). Vittae black. Arizona, Utah, Colorado, Texas .... *P. v. vau* Fall
19′. Vittae obsolescent, usually brownish. Texas........ *P. vau imperfectus* Fall

Results and Discussion

Taxonomic treatment in a revision such as this—as in any systematic study—is to a great extent a matter of subjective interpretation. In this paper, we have chosen to combine 3 separate species and to elevate one of Fall's former varieties to subspecific rank. Two of Fall's varieties are placed in synonymy. We conclude that *P. nigricornis* is a polymorphic species (morphologically as well as chromatically) which includes 3 polytopic and 1 monotopic subspecies. Mayr (1969) stated that "The only alternative to it [the polytopic subspecies] is not to recognize any subspecies in such a species." We choose to recognize subspecies in *P. nigricornis,* rather than just 1 species with variants, because the variations are taxonomically and geographically distinct.

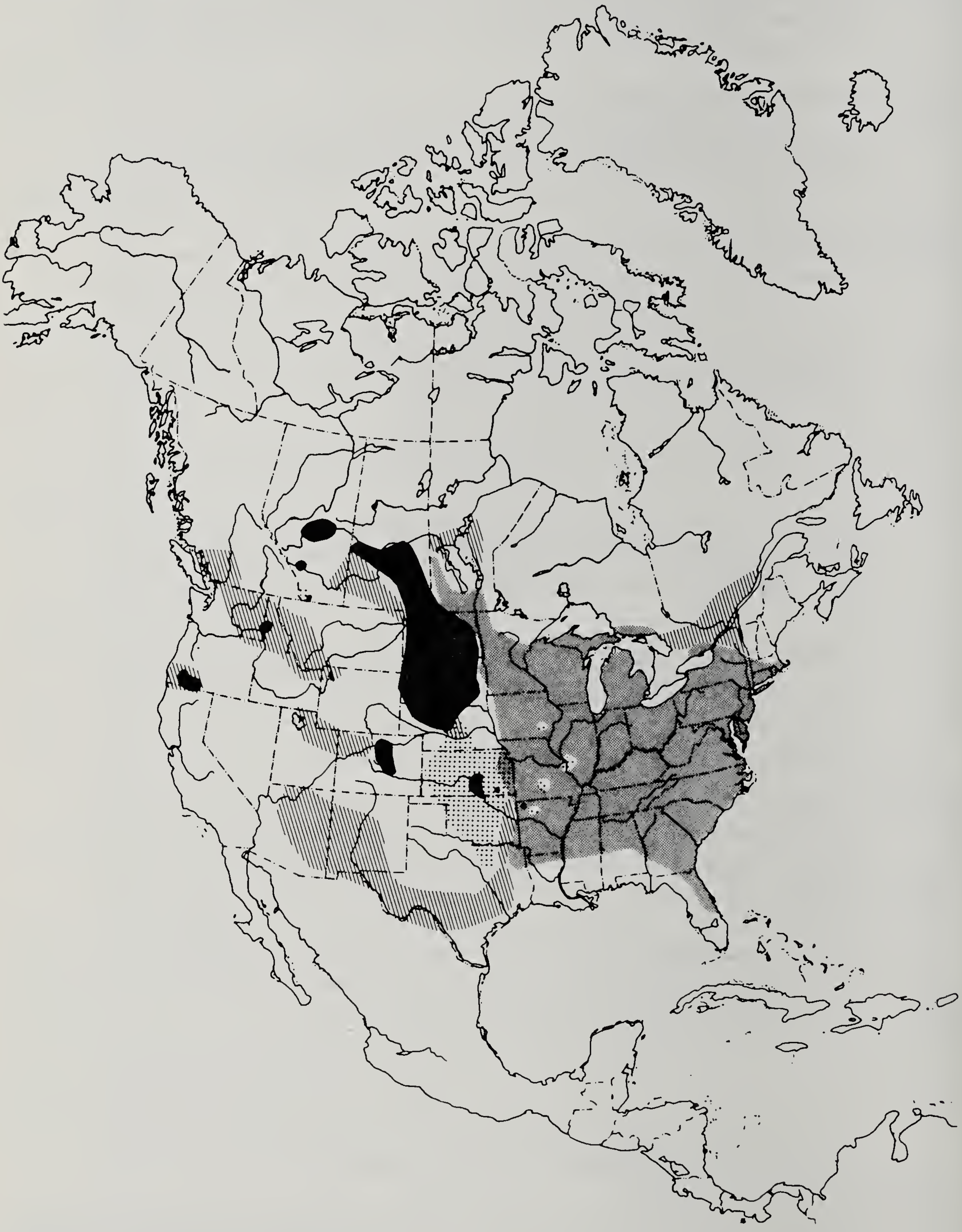

Fig. 12. Distribution of the subspecies of *P. nigricornis*. Solid black = *P. n. nigricornis*; grey = *P. n. carbonarius*; parallel lines = *P. n. difficilis*; dots = *P. n. autolycus.*

Mayr (1969) defined a subspecies as "an aggregate of phenotypically similar populations of a species inhabiting a geographic subdivision of the range of the species, and differing taxonomically from other populations of the species." Disagreement as to what constitutes "taxonomic differences" is at the crux of subjectivity. The subspecies of *P. nigricornis* differ most obviously by color characters. Such characters probably are determined by a complex of genes. Lus, as cited by Dobzhansky (1933), determined that color patterns in *Adalia bipunctata* and *A. decimpunctata* were controlled by at least 8 multiple allelomorphs, and that another gene determined only pronotal patterns. Multiple genes and allelomorphs likely control chromatic differences in *Pachybrachis* spp. also, and therefore the subspecies we recognize probably reflect variations tied to more than a single gene.

The following results were obtained from numerical taxonomic treatment. Table 1 shows the means and standard deviations for the 10 characters used. Table 2 is a within groups correlation matrix which is produced by a stepwise discriminant analysis. A correlation matrix is a symmetrical table of correlation coefficients of each variable in a set of variables with every other one. Of the characters that we used and of the manner in which we assigned values to them, none were totally independent. All characters, including the character index (#7), measured characters (#8, #9) and the ratio of the latter 2 (#10) were used in the discriminant analysis. The character index (#7) was used as a means of making subspecies groups. Four

Table 1. Means and standard deviations for 10 characters used in discriminant analysis of *P. nigricornis*.

Character	*P. n. nigricornis*		*P. n. carbonarius*		*P. n. autolycus*		*P. n. difficilis*	
	M	SD	M	SD	M	SD	M	SD
(1) Pronotal surface texture	1.56	0.50	1.10	0.30	1.74	0.44	1.74	0.44
(2) Pronotal punctation density	1.45	0.50	1.09	0.28	1.60	0.49	1.62	0.49
(3) Pronotal punctation size	1.32	0.47	1.03	0.17	1.57	0.50	1.17	0.38
(4) Pronotal coloration	1.66	0.64	1.01	0.09	3.64	0.48	3.00	0.34
(5) Elytral coloration	1.98	0.31	1.03	0.17	3.96	0.21	3.02	0.25
(6) Pygidial coloration	1.04	0.19	1.02	0.31	2.80	0.42	1.63	0.60
(7) Character Index	9.02	1.14	6.25	0.53	15.32	1.20	12.17	1.13
(8) Elytral width	17.97	2.00	17.58	1.84	17.83	1.98	18.05	1.97
(9) Elytral length	21.87	2.52	20.88	2.32	21.17	2.51	21.86	2.48
(10) Elytral ratio	0.82	0.04	0.84	0.04	0.84	0.03	0.82	0.07

Table 2. Within groups correlation matrix of 10 characters used in evaluating variation in P. nigricornis.

	1	2	3	4	5	6	7	8	9	10
1	1.0000									
2	.2360	1.00								
3	-.0134	.1088	1.00							
4	-.0230	-.0276	.0140	1.00						
5	-.1679	-.1956	-.1772	.2362	1.00					
6	.0067	-.0113	-.0316	.2118	.2020	1.00				
7	.4679	.5085	.3763	.5328	.1842	.4420	1.00			
8	.0526	-.0930	-.0576	.0474	.0675	.1097	.0482	1.00		
9	.0925	-.0656	-.0386	.0401	.0339	.0991	.0673	.9220	1.00	
10	-.1013	-.0113	-.0763	.0161	.0625	-.0086	-.0557	.0377	-.2643	1.00

groups were assumed, viz. *P. n. carbonarius* which were those specimens having a character index of 6-7, *P. n. nigricornis* 8-11, *P. n. difficilis* 12-13, and *P. n. autolycus* 14-17. The separate character values had been chosen so that low values were dark specimens and at the opposite extreme, high values were light specimens. Punctation and textural gradations were correspondingly assigned as well. Table 2 lists the means and standard deviations for the 10 characters used.

Fig. 13 is a discriminant analysis plot, based on the 10 characters and recognizing 4 populations. Of the 865 specimens used in the study, only 48 were misidentified; thus, 94.45 percent were correctly grouped by use of the character index. Thus the 4 subspecies are taxonomically distinct.

A discriminant analysis utilizing all 10 characters and 4 groups, based on geographic criteria was not conclusive. We feel that the geographic analysis was faulty because assignment of specimens to a geographic region, i.e. states or portions of states, was not a fine enough grouping. Fig. 12 accurately described the distribution of the subspecies of *P. nigricornis,* based on present material.[1] We have utilized the "75% rule" in compiling this map.

Pigmentation: Accumulation of pigments in animals of humid regions with a corresponding depigmentation in arid regions has been recognized for years, having been first verbalized as a rule by Gloger in 1833 who applied it to birds. This rule also holds true for many invertebrates. Some of the correlations of humidity-pigmentation in insects have been observed or demonstrated by Zimmermann (1931) in Vespidae; Netolitzky (1931) in Carabidae; Dobzhansky (1933) in Coccinellidae; Ford (1937), Hovanitz (1941), LeGare and Hovanitz (1951) in Lepidoptera; Balsbaugh (1973) in *P.*

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[1] Distribution records are on file and are available to interested persons. They are not published because of the archival nature of these data.

othonus (Chrysomelidae) and Hardwick and Lefkovitch (1973) in Noctuidae. However, Zuska and Berg (1974) cite many examples among poikilothermic animals for which this rule does not hold. In fact, there are cases of clinal progressions in the opposite direction.

Of the 4 subspecies of *P. nigricornis*, *P. n. autolycus* is the most lightly pigmented. It is found in the arid areas of Nebraska, Kansas, Oklahoma, etc. Hardwick and Lefkovitch (1973) stated that "the paler forms of *E. declarata* (Noctuidae) are characteristic of areas of low rainfall in the Great Basin and on the High Plains", which agrees greatly with the distribution of many *Pachybrachis* spp. (Balsbaugh 1973 and unpublished observations of the senior author). However, the many examples of *P. n. nigricornis* from areas of low rainfall in northwestern South Dakota and northwest into Saskatchewan and Alberta agree with the opposite correlations mentioned by Zuska and Berg (1974).

The phenotypes expressed in the various subspecies of *P. nigricornis* are adaptations to suit their particular environments. The discontinuous distributions of the polytopic subspecies, viz. *P. n. nigricornis, P. n. autolycus* and *P. n. difficilis,* most likely resulted from independent evolution of similar phenotypes which adapt their members to similar environmental pressures, rather than from these subspecies having evolved through disruption of a former more continuous range, or through macroleaps of dispersal. Voous (1951) showed that when species of birds from humid areas of Venezuela colonized arid islands in the West Indies, they independently evolved similar phenotypes, i.e. greater paleness and other features.

Zuska and Berg (1974) suggested that activity levels of poikilothermic animals are critically dependent on body temperatures and therefore temperatures of heliotherms are far more dependent on heat received from the sun than on metabolic heat. Intake of sunlight energy in them is greatly influenced by body color. Therefore dark pigments are advantageous in cold climates because they absorb radiant energy better. Dobzhansky (1933),

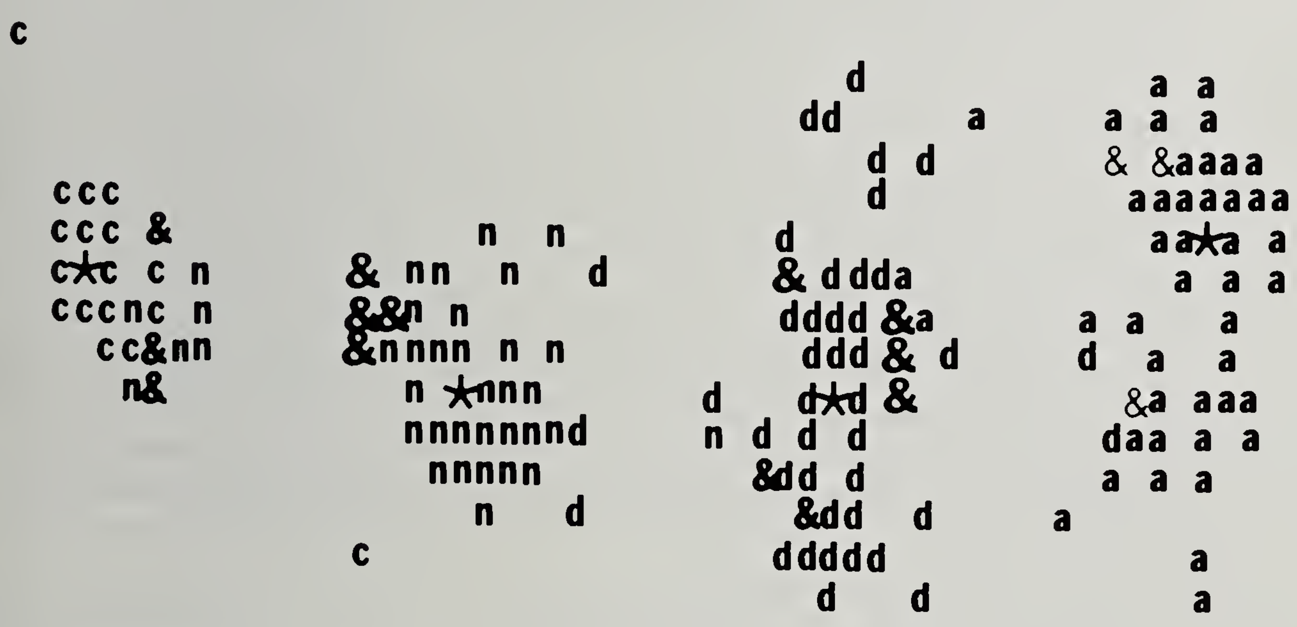

Fig. 13. Discriminant analysis plot for 10 characters when four groups are assumed. a = *P. n. autolycus*; c = *P. n. carbonarius*; d = *P. n. difficilis*; n = *P. n. nigricornis*; & = multiple entries and ★ = group means.

on the other hand, said that pigmentation " . . . seems to be related to the degree of humidity, and possibly, to the temperature prevailing in a given region . . . The role of humidity seems to be more important than that of temperature since the increase of pigmentation is observed in some species (of Coccinellidae) in humid but otherwise so different countries in northeastern Siberia, Japan, northern Europe, Abyssinia and Himalya."

In South Dakota, the annual average mean temperature, except for the Black Hills, decreases from south to north. To the contrary, annual average rainfall declines from east to west. Balsbaugh (1973) demonstrated that in *P. othonus,* in South Dakota, pigmentation is correlated with rainfall amounts, i.e. darker specimens correspond with areas of greater rainfall. In *P. nigricornis,* it appears that temperature and humidity may both be important as environmental selective pressures.

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* * *

CHANGE OF THE GENUS NAME *PSEUDAMARA* LINDROTH 1968 TO *DISAMARA* (COLEOPTERA: CARABIDAE)

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In my "Ground-beetles of Canada and Alaska", part 5, 1968:653, I erected *Pseudamara* as a new monotypic genus for the North American species *arenaria* LeConte, previously referred to *Amara* Bonelli. I was unaware that Baliani (1934:190) had already used the subgeneric name *Pseudoamara* for his new species *A. beesoni* from Assam, India. According to Hieke (1975:285, 334, 336) *A. beesoni* Baliani is a synonym of *A. birmana* Baliani, belonging to the subgenus *Amara s. str.* Also, Hieke changed the original spelling of *Pseudoamara* to *Pseudamara,* which must be regarded as a justified emendation (International Code 1961, art. 58 (8)). *Pseudamara* Lindroth is therefore a homonym of *Pseudoamara* Baliani and requires a new name, as follows:

Disamara Lindroth 1976 (*novum nomen* for *Pseudamara* Lindroth 1968:653, *nec Pseudoamara* Baliani 1934:190). Description and type-species as given in 1968.

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—Paul P. Shubeck

* * *

THE BIOLOGY OF *DYNASTES TITYUS* (LINN.) IN MARYLAND (COLEOPTERA: SCARABAEIDAE)

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Abstract

The larval biology of *Dynastes tityus* (Linn.), a large eastern dynastine scarab, has been investigated in Maryland where larvae have been found to develop in oak tree holes. Details of distribution, abundance, and larval activity are presented and discussed in relation to the activities of other tree hole scarabs such as *Osmoderma* and *Phileurus*. Competition for the same larval niche may be a factor affecting the distributions of *Dynastes* and *Osmoderma*.

Introduction

Dynastes tityus (Linn.), widely known to most coleopterists as the largest of the eastern dynastine scarabs, occurs over nearly the entire Atlantic and Gulf Coastal Plains as well as north through the Mississippi Valley. The beetle is relatively common in some southern states, and has upon occasion been taken in large numbers. Manee (1915) reported collecting many hundreds of specimens on ash (*Fraxinus*) trees in North Carolina during the course of a summer, and as many as 387 from a single tree. Such experiences appear exceptional, however; most of the specimens in collections have been taken singly, chiefly at light.

Published information concerning the larva or larval biology of *D. tityus* is scarce. Some aspects of the life history of the species were discussed by Chittenden (1899), and the third stage larva was described and keyed by Ritcher (1966). Manee (1915) reported finding larvae in "rotting side roots of old pine stumps" at Southern Pines, North Carolina, whereas Ritcher (1966) listed decaying cherry (*Prunus*), black locust (*Robinia*), oak (*Quercus*), pine (*Pinus*), and willow (*Salix*) as larval hosts.

Larval Biology

My observations indicate that all of the larval associations reported above with the exception of oak are atypical, at least in Maryland, and moreover that the habitat relative to oak is apparently far more specific than decaying wood *per se*. Based on investigations in the field over the past 2 years, chiefly in the Maryland Coastal Plain, it has become clear that *D. tityus* undergoes larval development in tree holes or cavities in the trunks of various species of oaks. Following the initial discovery of this fact, an intensive examination of tree holes in all types of hardwoods and conifers was undertaken, during which more than 600 such cavities were investigated. My early suspicion that oaks were indeed the larval host of *D. tityus* has been borne out by the results. Some 400 or more larvae, pupae, and adults were taken from approximately 80 tree holes, all but 2 of the cavities in oaks. The 2 exceptions noted were a single third stage larva in a cavity in a mature tulip tree (*Liriodendron tulipifera* L.), and 5 third stage larvae found in a basal tree hole in a bitternut hickory (*Carya cordiformis* Wang.).

The tree holes selected by *Dynastes* are almost invariably large cavities at or near the bases of the trunks of mature trees. Trees with such cavities, and in particular oaks, tend to occur in groups rather than singly within a given tract of woodland, a fact consistent with the probable origin of the cavities as a consequence of scarring by ground fires. The scars admit a variety of fungi which pervade and progressively destroy the heartwood, ultimately resulting in an open cavity floored with a deep accumulation of granular woody debris. Access to the cavity, for both the beetle and the collector, is through an opening a few inches wide to several feet in diameter. Oaks with tree holes sufficiently large to accommodate full larval development of a beetle the size of *Dynastes* are nearly always mature.

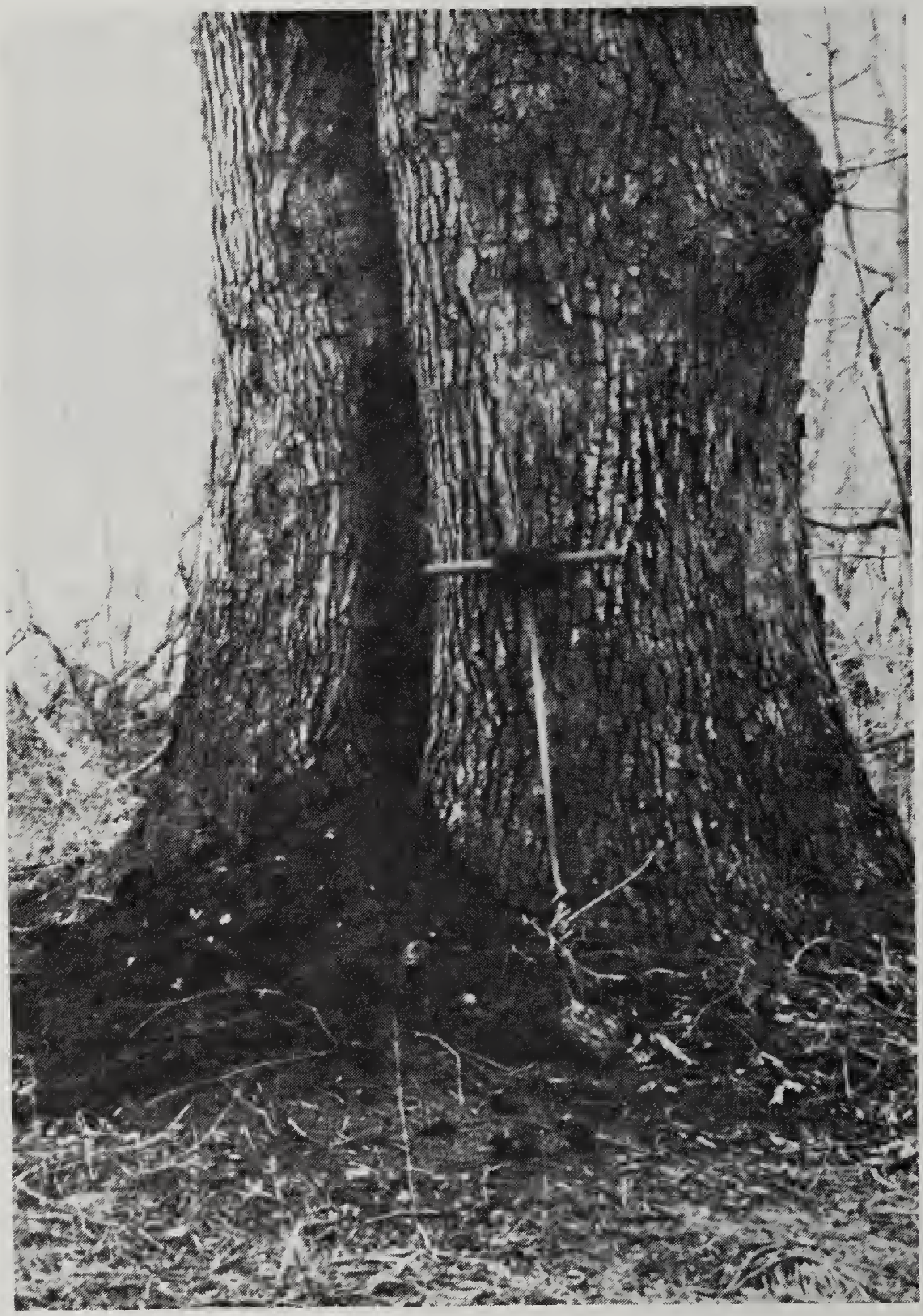

Fig. 1. Basal tree hole in mature oak—typical larval niche of *D. tityus*.

Very old oaks with trunk diameters of 1 to 1.5 meters are far more likely to contain basal cavities than younger, smaller trees (Fig. 1).

Dynastes larvae feed exclusively in the granular debris which collects at the base of the cavity, converting it to characteristically flattened, rectangular fecal pellets about 10 mm long. In most instances, the feeding depth ranges from a few centimeters to 45 cm below the surface of the debris, but larvae have been dug out from as deep as 76 cm. Oviposition apparently takes place in Maryland in August, as female beetles are rarely encountered in tree holes prior to the first week in August. Eggs, typically white to dirty-yellow elongate ovoids measuring 4-5 mm in length, have been taken from the debris in the holes in early October; 12 such eggs collected on October 13, 1975, hatched within 3 to 7 days. First stage larvae (about the size of a penny in curled position) have been collected in November and reared to adult beetles under artificial conditions. The fact that these larvae fed for 22 months before pupation lends support to Ritcher's (1966) suggestion of a 2-year life cycle, but inasmuch as feeding continued unabated throughout the winter months in a heated basement, the life cycle of *Dynastes* in nature may be as long as 3 years in Maryland. Moreover, some large cavities have yielded grubs in all stages of development as well as pupae or unemerged adults, indicating repeated oviposition in the same tree hole until all food material has been exhausted.

Some assessment of brood size can be made from the numbers of same stage larvae, pupae, or unemerged adults encountered in individual cavities. The range in numbers is large—1 to 91—with an average of 14. Both very low and very high numbers of larvae are questionable brood estimates, and may simply reflect high larval mortality at the low end and multiple oviposition in a single season at the opposite end of the scale. The latter is almost certainly true in the case of a single large tree hole which yielded 91 adult *D. tityus* as well as numerous larvae and eggs.

Pupation of third stage larvae begins in Maryland by early August. A thick-walled oval cell of woody debris and fecal pellets is constructed by the larva within the material in the cavity, generally a few centimeters beneath the surface. Moreover, the cells are commonly tightly grouped—1 cavity examined contained 18 such cells in a space 30 × 30 × 10 cm. The pupal stage lasts until late September, or 6 to 8 weeks; Chittenden (1899) cites 51 days for reared individuals. By the last of September, I find only newly-transformed beetles in cells where they remain until normal emergence during the following June or July. I have taken numerous adult *D. tityus* by digging out cells from tree holes during the winter months. Such winter collecting offers the welcome advantage of relative freedom from unpleasant surprises provided by opossums, skunks, sundry birds, and nesting honeybees, all of which also frequent tree holes. Also of interest is the preponderance of males over females in almost all of the individual broods examined. In fact, the aggregate ratio of males to females is nearly 2 to 1.

Distribution in Maryland

It is instructive to examine certain aspects of the distribution of *D. tityus*, particularly in Maryland and the states north and east of Maryland. Plotted in Figure 2 are locality records for this species in the area north of the Maryland-Virginia boundary, based on data compiled from the literature, institutional collections as cited, and my observations. The data suggest that the Southern Maryland Coastal Plain and probably the Delmarva Peninsula hold the northernmost breeding populations of *Dynastes* with scattered records in Pennsylvania, New Jersey, and Long Island representing stragglers. In Anne Arundel County, just south of Baltimore, the northern limit of common larval activity is well marked and falls at about mid-County, about 24 km. (15 miles) south of the city. Although the abundance of oaks and tree holes remains much the same throughout the County as well as to the north and northeast of Baltimore, evidence of larval feeding decreases rapidly northward, and none has been found in forested areas above Baltimore despite a concerted search.

ZOOGEOGRAPHY OF TREE HOLE SCARABS

Oak tree holes are utilized in Maryland by the early stages of scarabs other than *Dynastes,* in particular *Osmoderma eremicola* Knoch and *O. scabra* (Beauv.), and probably *Phileurus castaneus* Hald. The larval biology of *Osmoderma* has been discussed by Hoffman (1939) and Ritcher (1966), and is fairly well understood. In Maryland, *O. eremicola* undergoes larval development in tree holes, chiefly in oaks but occasionally in other hardwoods, and has larval feeding habits closely similar to those of *Dynastes* including a preference for cavities at the base of the trunk. Unlike

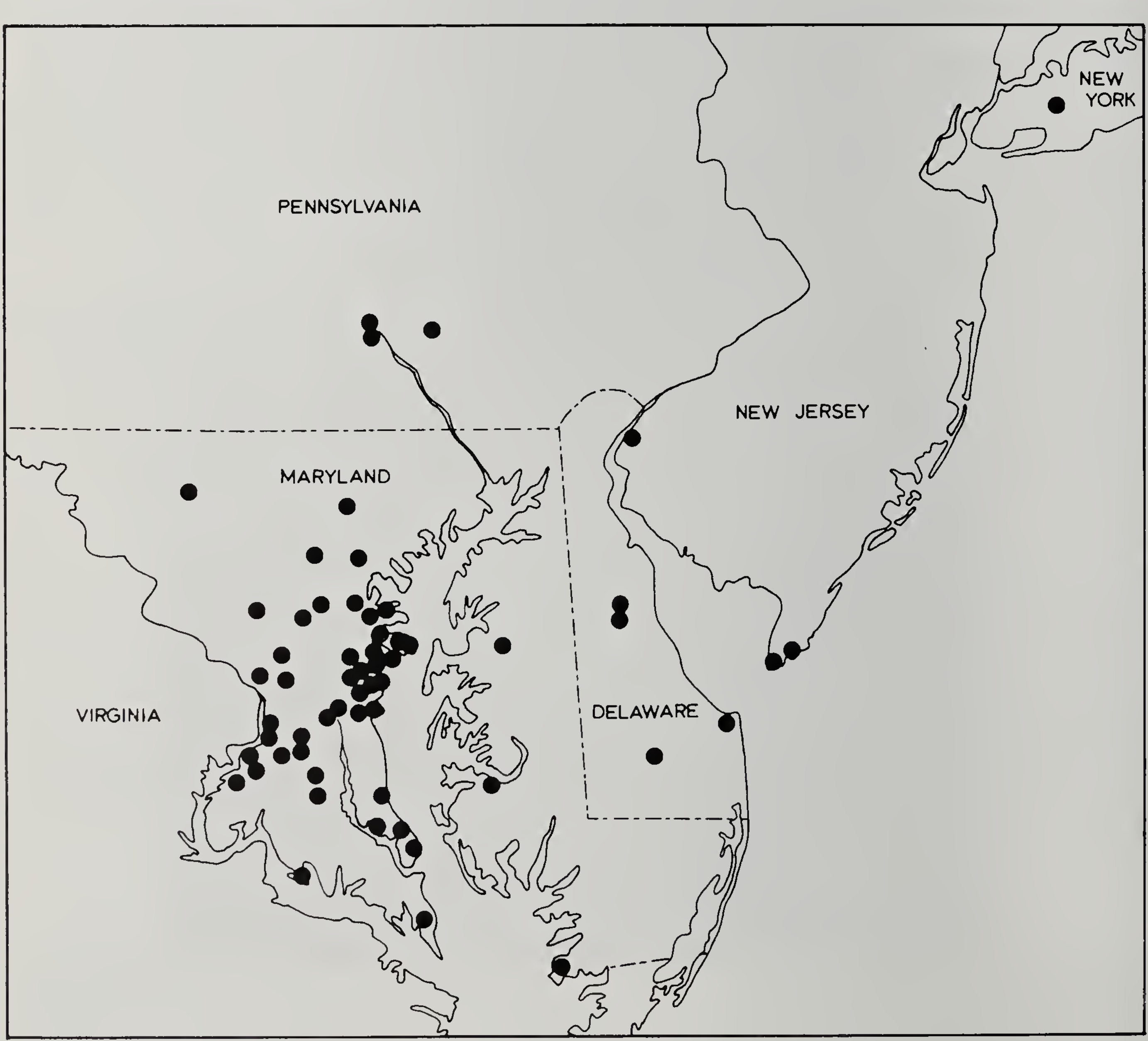

Fig. 2. Distribution of *D. tityus* north of the Maryland-Virginia boundary.

Dynastes, however, *O. eremicola* may at times be found in cavities higher in the bole or in large lateral branches. Larvae of *O. eremicola* are common in central and western (Piedmont and Appalachian) Maryland, considerably less common in the eastern and southern Coastal Plain portions of the State, and rare in the southernmost counties.

O. scabra is far less selective in larval habitat, and may be encountered not only in tree holes of all types but also under bark of standing dead trees, stumps, and logs of a variety of hardwoods. Further, this species is practically confined to the Piedmont and Appalachian provinces of the State.

In my experience, larvae of *Osmoderma* and those of *Dynastes* are never found feeding in the same cavity. Moreover, the distributions of the 2 taxa in Maryland are nearly allopatric with a zone of overlap in the inner Coastal Plain. The range of *Dynastes tityus* in North America and that of the genus *Osmoderma* (Fig. 3) suggests a similar degree of isolation. *Dynastes* is doubtless a relatively ancient element in the American fauna, perhaps established by Miocene time (Howden, 1966). It is also likely that this genus survived the Pleistocene glaciations in North America along with many other scarabaeid groups in hardwood forest refugia in Florida or other Gulf Coast areas. If so, the present distribution of *D. tityus* parallels the reinvasion by the deciduous forest of the Atlantic Coastal Plain and the Mississippi Valley beginning about 14,000 yrs. B. P. (Maxwell and Davis,

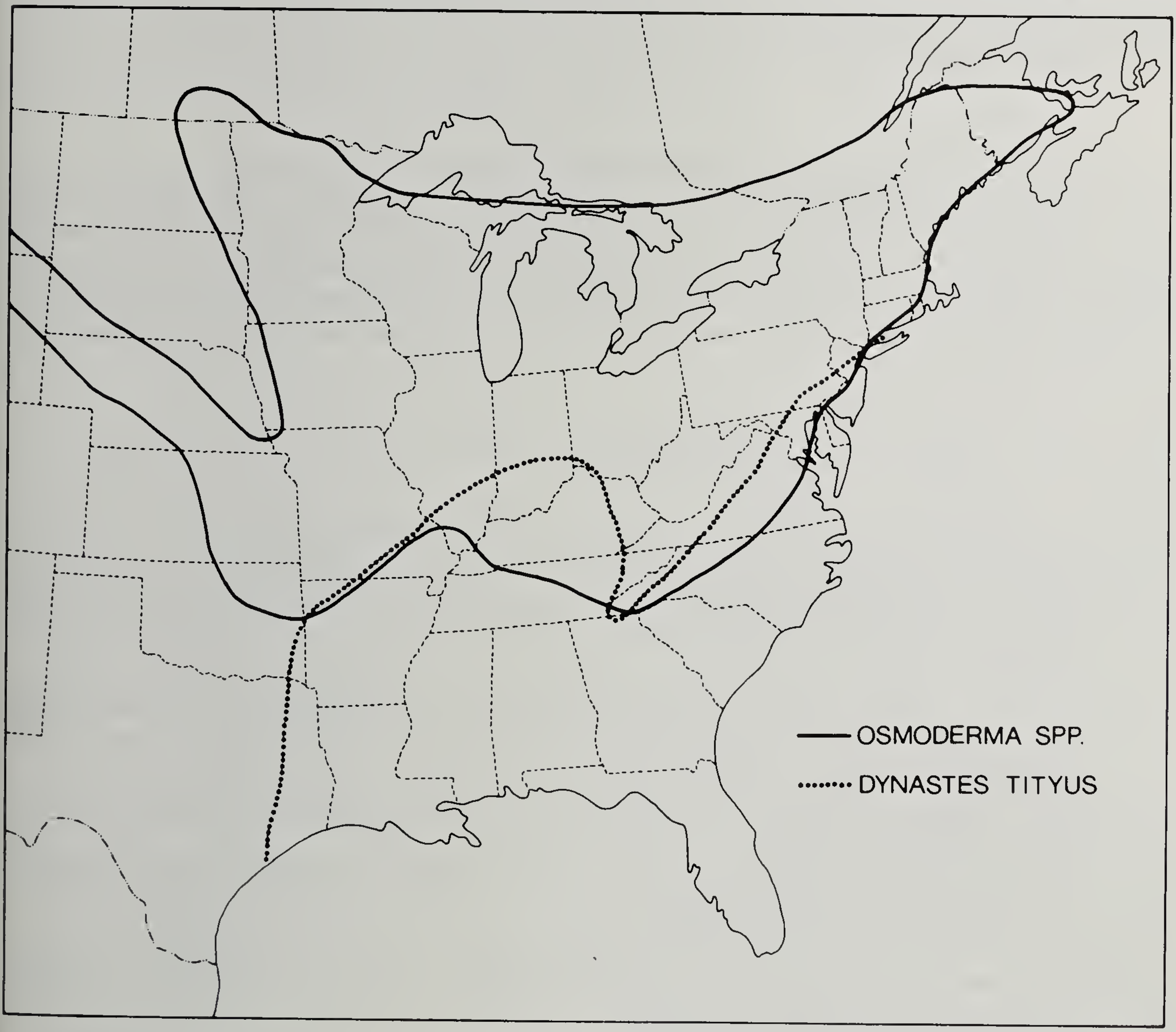

Fig. 3. North American distribution of *D. tityus* and aggregate range of *Osmoderma* ssp. (*Osmoderma* distribution from Howden, 1968).

1972). *Osmoderma,* on the other hand, appears to be a more recent invader from the Old World fauna, possibly even post-Wisconsin. The close similarity among Asian, European, and American species as well as the typically northern distribution of the genus in North America appears to bear out this supposition. If this was indeed the case, the present separation of *Osmoderma* and *Dynastes* may reflect competition for the same environmental niche more than any other factor.

Earlier reference was made to the dynastine *Phileurus castaneus* Hald. as a probable tree hole associate. Some brief discussion of the biology of *Phileurus* is pertinent although the available data are insufficient for meaningful conclusions. Literature distribution records and my observations point to Southern Maryland as the northern limit of this species. I have taken a half dozen specimens in Charles County, all from oak tree holes, but none have been associated with larvae nor have any unassociated larvae from this niche been reared to *Phileurus* adults. However, numbers of a congener, *P. truncatus* (Boh.), were obtained from larvae and pupae dug from oak tree holes in Myrtle Beach State Park, South Carolina. In this instance, most of the cavities containing *Phileurus* were located high in the boles of largely hollow, dead trees with severed crowns. Presumably, then, both species of *Phileurus* utilize tree holes, again primarily in oaks, for larval development. The type of cavity and its location within the trunk may differ from the typically basal cavity preferred by *Dynastes.* However, the evidence bearing on this point is meagre, and final conclusions must await further investigation.

ACKNOWLEDGMENTS

I am indebted to Paul Spangler for information regarding specimens in the U. S. National Museum, to Paul Barbutis for similar information from the University of Delaware collection, and to David Rentz for data on specimens in the collection of the Academy of Natural Sciences, Philadelphia. I should also like to thank Henry F. Howden, Dept. of Biology, Carleton University, Ottawa, for helpful suggestions in preparing the manuscript.

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A REVIEW OF THE TACHYPORINE GENUS *EUCONOSOMA* CAMERON (COLEOPTERA: STAPHYLINIDAE) WITH A DESCRIPTION OF A NEW SPECIES FROM NEPAL

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Abstract

The genus *Euconosoma* Cameron is reviewed. One new species, *E. nepalensis,* is described from Nepal. *Conosoma pictum* Bernhauer is transferred to *Euconosoma. Euconosoma elegans* Cameron is placed in synonymy with *E. pictum.*

The genus *Euconosoma* was described by Cameron (1918) to include only his new species *E. elegans,* herein treated as a junior synonym of *Conosoma pictum* Bernhauer (1903). Cameron compared the genus to *Conosoma* (now *Sepedophilus*) but placed it into a new group (= tribe) the Euconosomini. One specimen of a new species of *Euconosoma* was collected by the 1967 Canada Nepal Expedition and is herein described.

All methods and terminology used in this paper have been described in my revision of the North American species of *Sepedophilus* (in press). The units used to express relative lengths of antennal and tarsal segments are equal to 0.01 mm.

I thank Mr. Henry Dybas, Field Museum of Natural History, Chicago, for the loan of specimens from the Bernhauer collection, Mr. Go Sato for making the habitus and line drawings, and my colleagues Drs. E. C. Becker, D. E. Bright, and Aleš Smetana for criticism of the manuscript.

Euconosoma Cameron

Euconosoma Cameron 1918:215 [type-species *Euconosoma elegans* Cameron, junior synonym of *Conosoma pictum* Bernhauer].

The genus was adequately characterized by Cameron so the description need not be repeated. The following diagnosis distinguishes members of the genus from all other Tachyporinae.

Body with facies of *Sepedophilus,* strongly convex; surface distinctly and moderately densely pubescent; bicolored. Elytra with series of long lateral bristles (Fig. 1); elytral epipleura subacute (see Campbell, in press), not visible from lateral view. Abdomen with dense, long bristles on all tergites and sternites. Antenna slightly compressed laterally, with segments 5-10 becoming gradually wider approaching apex. Maxillary palpus 4-segmented with apical segment triangular, slightly narrower at base than segment 3, then sides evenly tapering to acute apex. Labial palpi (Fig. 2) 3-segmented with apical segment greatly widened and compressed laterally, width greater than length of basal 2 antennal segments. Mesosternum (Fig. 3) evenly convex, without trace of median carina. Anterior tibia (Fig. 4) with dense comb of coarse, even spines along outer margin.

Remarks. Euconosoma and *Sepedophilus* superficially are very similar in appearance, readily distinguished from all other Tachyporinae by the strongly convex body, the distinctly pubescent body surface, and the unique comb of spines along the outer margin of the protibia. *Euconosoma* is distinguished from *Sepedophilus* by the greatly expanded apical segment of the labial palpus and by the lack of a mesosternal carina.

The presence of long bristles on the sides of the elytra and the distinctive testaceous color with strongly contrasting black markings make *Euconosoma* similar to species of the *scriptus* group of *Sepedophilus.* In addition to the generic differences cited above, species of *Euconosoma* are considerably larger than any of the species of the *scriptus* group (which are less than 2 mm long from anterior margin of head to apex of elytra).

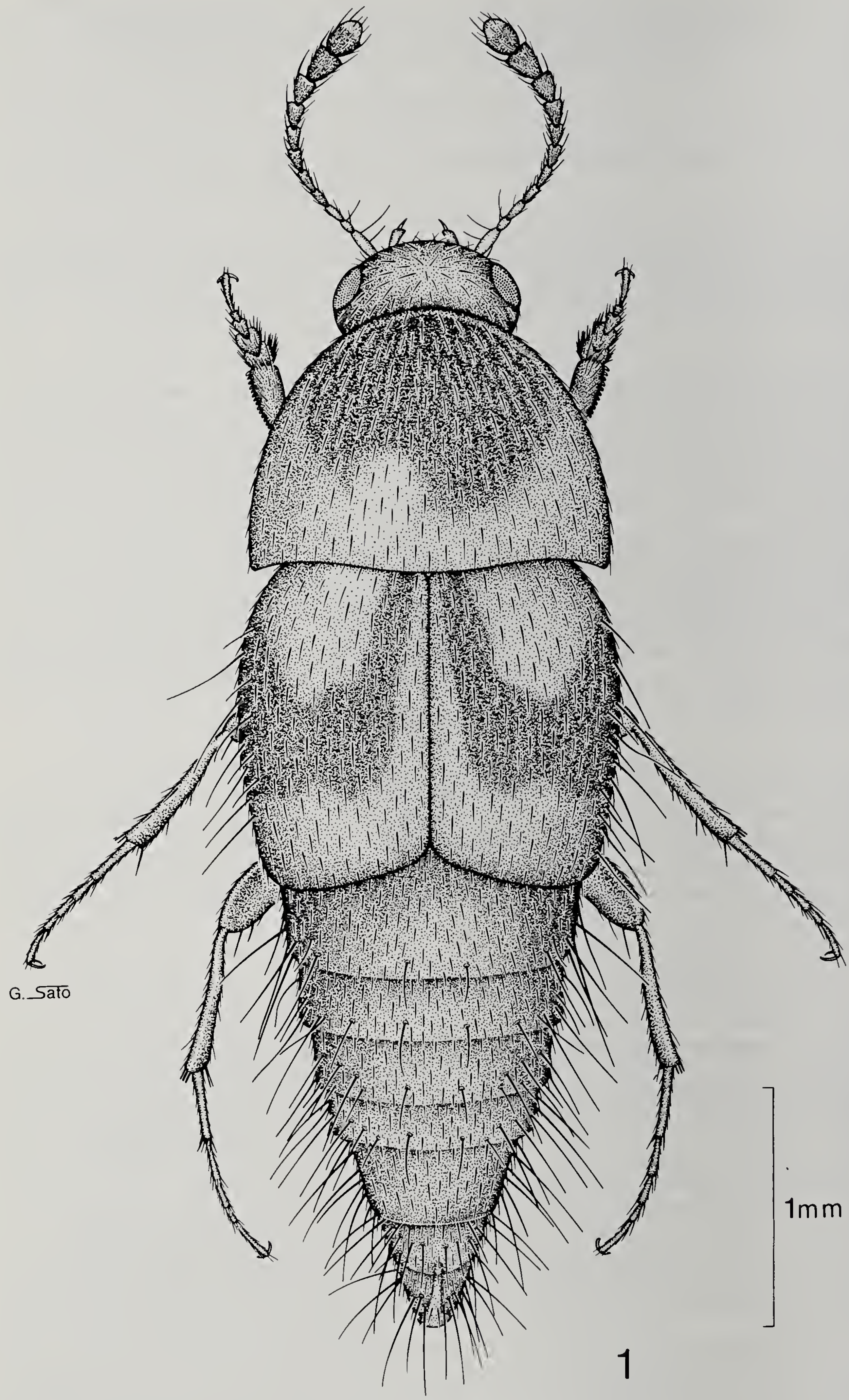
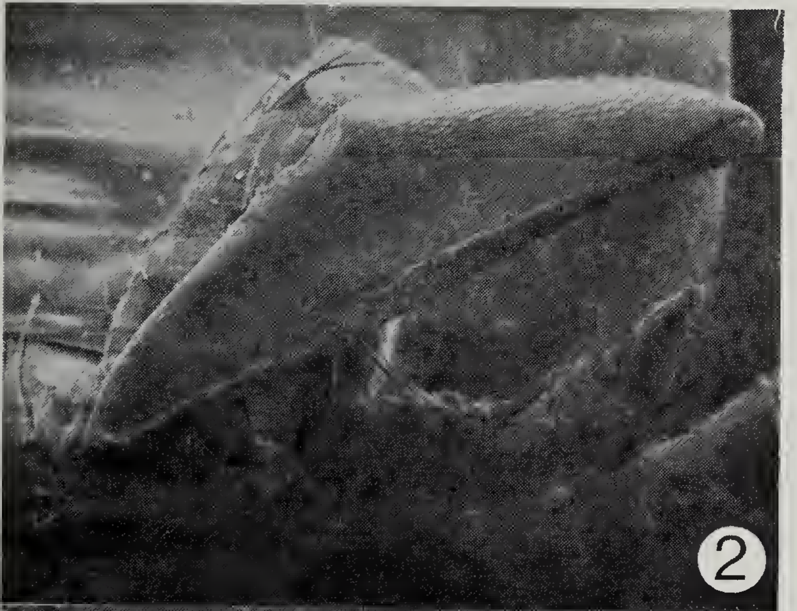


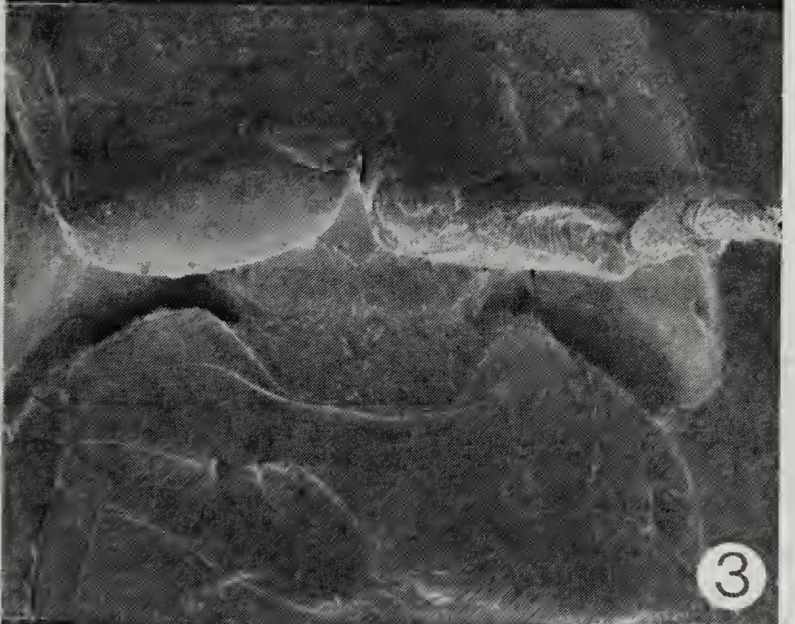
Fig. 1. Habitus of *Euconosoma nepalensis.*

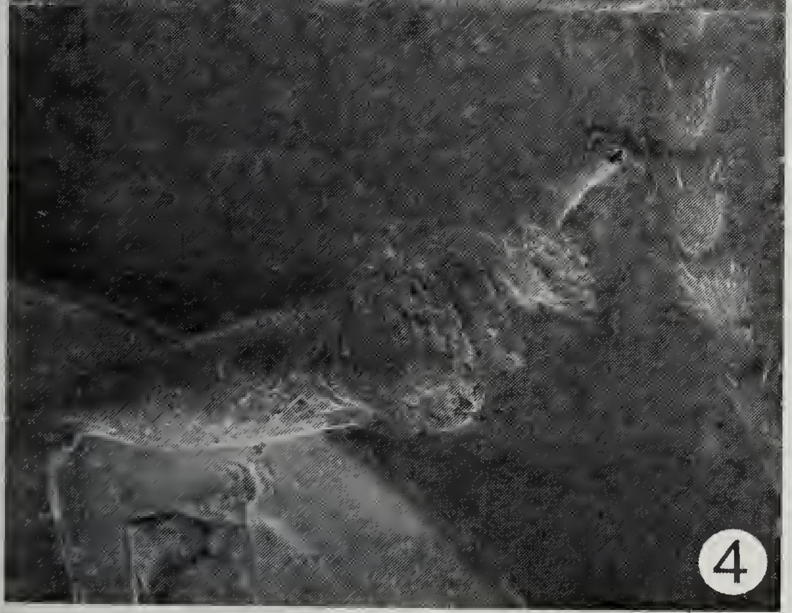
Euconosoma nepalensis Campbell, **new species**

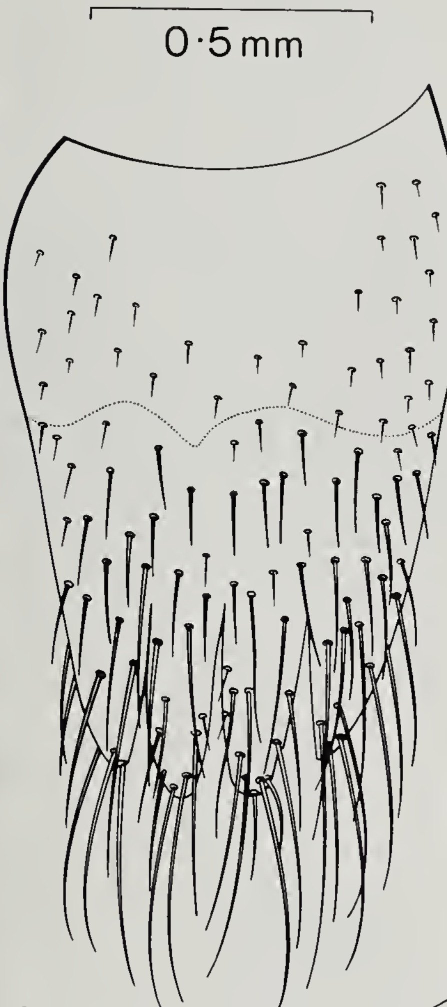
Figs. 1, 7-11

Body (Fig. 1) strongly convex, broadly elongate-oval, broadest across pronotum near base and across base of elytra; sides forming almost continuous curve from near base of pronotum around anterior margin of head, posteriorly sides almost evenly tapering from base of elytra to apex of abdomen. Testaceous; central portion









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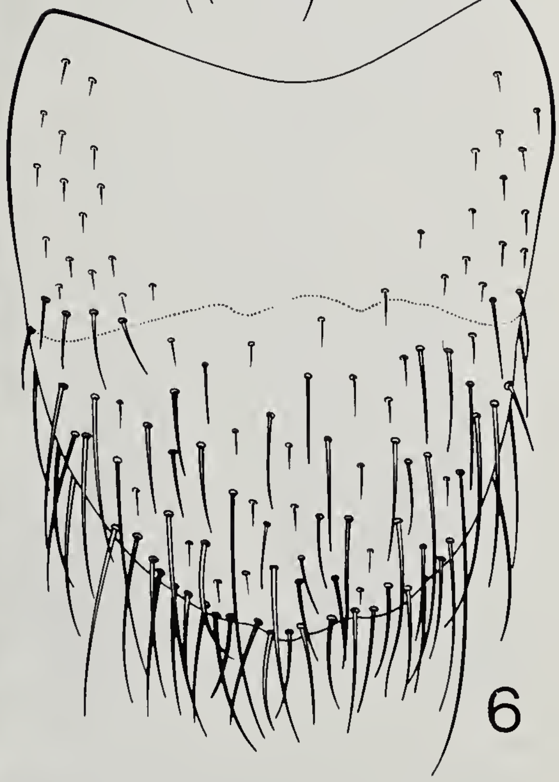

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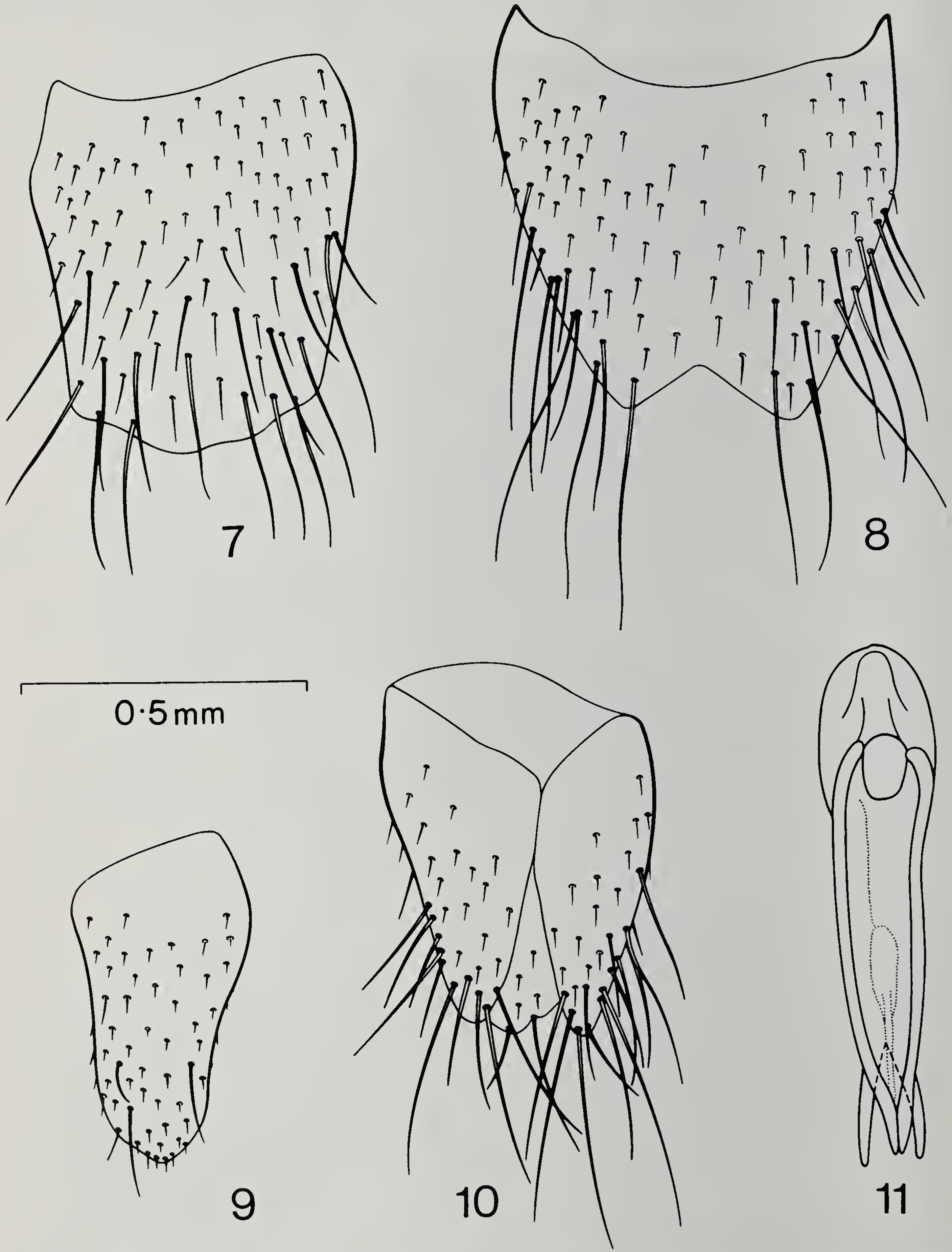
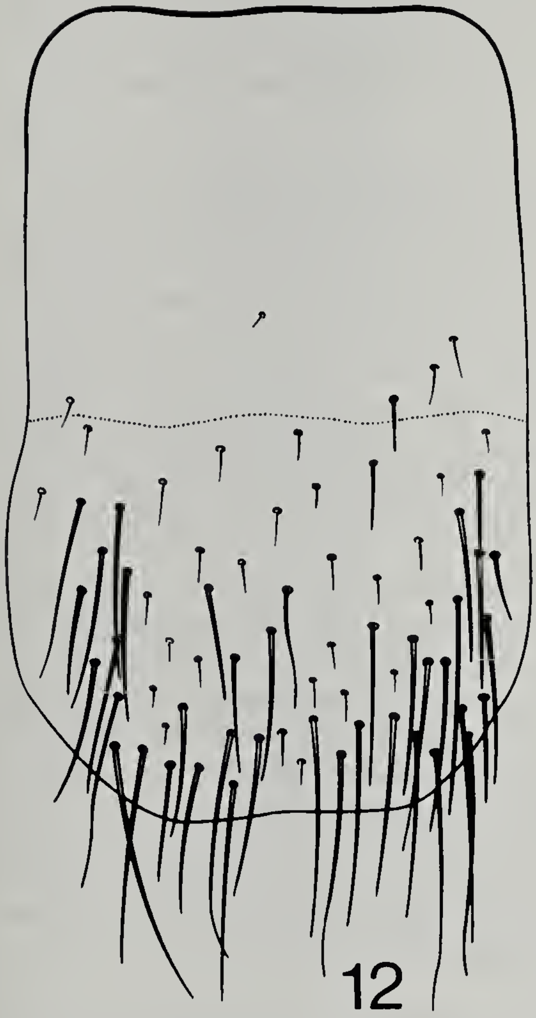
Figs. 2-6, *Euconosoma pictum,* female: 2, labial palpus; 3, mesosternum; 4, anterior leg; 5, eighth tergite; 6, eighth sternite.

of pronotal disc, large crescent-shaped macula extending from scutellum to just behind humeral angles of each elytron, apical 3/4 of abdominal segment 3, segments 4-6, segment 8, metasternum, and segments 4-11 of antenna piceous. Surface of head and pronotum shining, without microsculpture; finely, moderately sparsely punctate. Pubescence fine, moderately long, testaceous. Length from front of head to apex of elytra 2.9 mm.



Figs. 7-11, *Euconosoma nepalensis,* male: 7, eighth tergite; 8, eighth sternite; 9, ninth tergite; 10, ninth sternite; 11, genitalia.

Figs. 12-16, *Euconosoma pictum,* male: 12, eighth tergite; 13, eighth sternite; 14, ninth tergite; 15, ninth sternite; 16, genitalia.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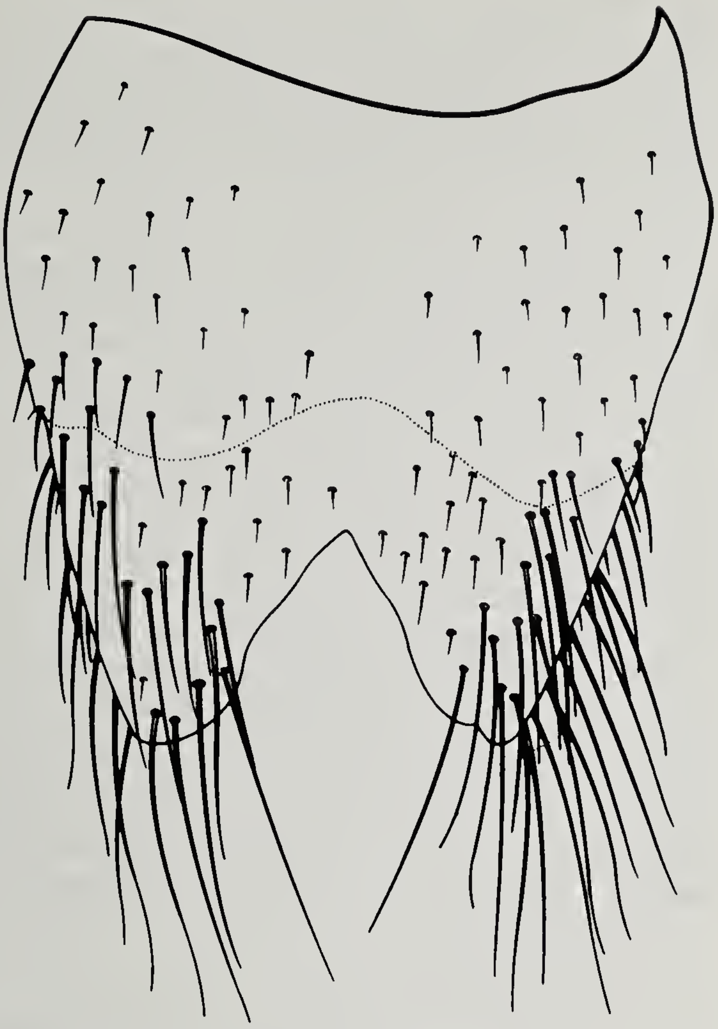
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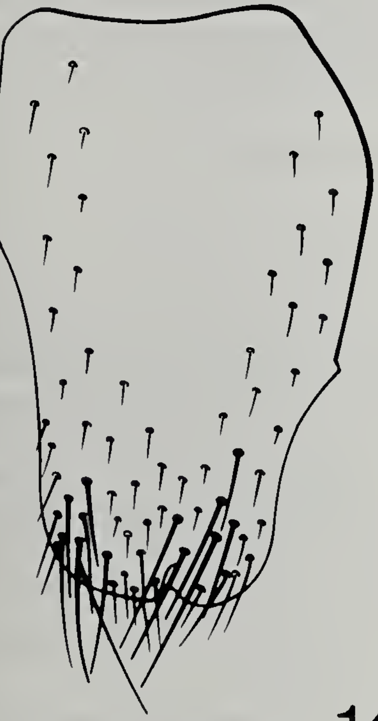
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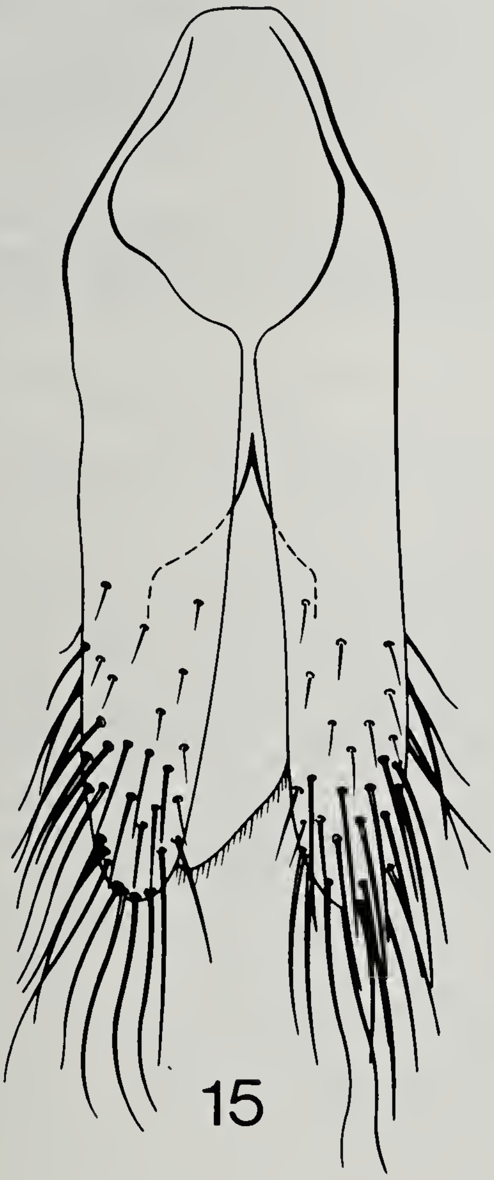
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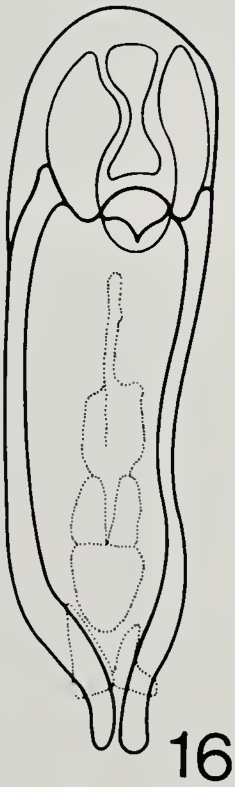
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0·5 mm

Maxillary palpus with apical segment subequal in length to penultimate and slightly more than half as wide; sides narrowed from base to acute apex. Antenna distinctly compressed laterally; segments 3-10 subequal in length, becoming distinctly broader approaching apex; segment 3 elongate (l/w = 14/6); segment 4 elongate triangular (l/w = 15/10), segment 10 triangular (l/w = 14/14); segment 11 asymmetrical, surface broadly, concavely excavate on outer side, slightly longer than wide (l/w = 16/13).

Pronotum transverse (l/w = 1.4/1.65 mm), with basal margin broadly convex, basal angles broadly rounded; apical margin broadly emarginate with anterior angles acute. Elytra subequal in length to pronotum; disc with row of long bristles along lateral margin and row of slightly shorter bristles just mediad of outer row (Fig. 1); elytral epipleura subacute, narrow, tapering from base and not quite extending to apex of elytra, glabrous. Fully winged.

Abdomen with numerous long bristles (see Fig. 1); tergite 7 with apical margin bordered by white seam. Procoxa with 3 short, coarse spines on apex. Protibia without apical spurs or ctenidium. Mesofemur with 1 long and 2 shorter bristles on inner side near apex; mesotibia with 2 long, subequal apical spurs, apex with complete apical ctenidium; ratio of lengths of mesotarsal segments 22: 12: 10: 6: 21. Metatarsal segments with relative lengths 39: 15: 12: 7: 19.

Male. Protarsus with basal 3 segments broadly dilated. Tergite 8 (Fig. 7) uniformly piceous; apical margin broadly bisinuate. Sternite 8 (Fig. 8) uniformly piceous; apical margin broadly, deeply, triangularly emarginate. Tergite 9 (Fig. 9) with apical margin broadly triangular; sternite 9 as in figure 10. Genitalia (Fig. 11) 0.93 mm. long; parameres moderately broad near middle, then curved towards middle and evenly tapering to acutely rounded apex; processes of median lobe divergent apically, extending slightly beyond level of apices of parameres.

Female. Unknown.

Type. Holotype, male, mounted on card with labels as follows: NEPAL, Ktmd. [Katmandu] Godavari 6000′, 7-13 Aug. 1967, Can. Nepal Exped./HOLOTYPE [male sign] Euconosoma nepalensis, J. M. Campbell CNC No. 13722. The specimen is deposited in the Canadian National Collection, Ottawa.

Remarks. Euconosoma nepalensis is superficially similar to *E. pictum* (Bernhauer) but is distinguished by its smaller size, different color pattern, different shape of male terminalia, and the presence of 2 rows of bristles along the outer margin of each elytron.

Nothing is known of the habits of this species, but the presence of well developed ctenidia on the legs, the protibial combs, and the large number of bristles on the legs imply that the species is mycetophilous as are species of *Sepedophilus*.

Euconosoma pictum (Bernhauer), **new combination**

Figs. 2-6, 12-16

Conosoma pictum Bernhauer, 1903, p. 25 [type locality, Sumatra].

Euconosoma elegans Cameron, 1918, p. 216 [type locality, Borneo, Quop, W. Sarawak]. **New synonymy.**

This species was adequately described by Cameron (1918); the following diagnosis and additional characters distinguish the species. Testaceous; temples and posterior margin of head, central portion of pronotal disc, elytra except middle of base and sutural area, middle of abdominal tergite 4, segments 5 and 6, basal half of segment 7, apical half of segment 8, and antennal segments 5-10 black. Length from front of head to apex of elytra 3.4-3.8 mm. Antenna distinctly compressed laterally; segments 4-10 becoming gradually shorter and wider approaching apex; segment 3 elongate (l/w = 25/7); segment 4 elongate (l/w = 28/10); segment 5 triangular (l/w = 20/12); segment 10 transverse-triangular (l/w = 15/17); segment 11 asymmetrical, surface flattened on outer side, slightly longer than wide (l/w = 20/15).

Pronotum transverse (l/w = 1.80/2.15 mm). Elytra distinctly shorter than pronotum (length 1.25 mm); disc with single row of 8-10 moderately long bristles along outer margin; elytral epipleura subacute, moderately broad, tapering from base for basal half then subparallel to apex of elytra, glabrous. Fully winged. Abdomen lacking bristles on central portions of tergites 3-7; apical margin of tergite 7 bordered by white seam. Procoxa with anterior surface moderately densely covered with short spines. Protibia without apical spurs or ctenidum. Mesofemur as in *nepalensis*; mesotibia with complete apical ctenidium, with 1 long and 1 short tibial spur;

ratio of lengths of mesotarsal segments 16: 5: 4: 3: 12. Metatarsal segments with relative lengths 18: 6: 4: 2: 12.

Male. Protarsus with basal 4 segments broadly dilated. Tergite 8 (Fig. 12) with apical half piceous, apical margin broadly truncate. Sternite 8 (Fig. 13) with apical half piceous; apical margin broadly, deeply, triangularly emarginate. Tergite 9 (Fig. 14) with apical margin truncate; sternite 9 as in figure 15. Genitalia (Fig. 16) 1.08 mm. long; parameres abruptly curved towards middle just before apex, apical portion subparallel with apices evenly convex; processes of median lobe convergent apically, not extending to level of apices of parameres.

Female. Tergite 8 (Fig. 4) 4 lobed; median lobe extending slightly beyond level of apices of lateral lobes; median emargination extending to base of lobes. Eighth sternite (Fig. 5) with apical margin convex, slightly produced medially, with 15 apical fimbriate setae which are obscured by dense bristles of disc.

Material examined. I examined 3 specimens from the Bernhauer collection, Field Museum of Natural History, Chicago. Two of these are syntypes of *pictum* Bernhauer and the 3rd is from the type locality of *elegans* Cameron. I designate a male with the following labels as lectotype of *pictum*: Dohrn, Sumatra, Soekaranda/ pictum Brh. det. Bernh./Chicago NH Mus. M. Bernhauer Collection/LECTOTYPE male Conosoma pictum Bernh., desig. 1975, J. M. Campbell/Euconosoma pictum Bernh. det. 1975, J. M. Campbell. The 2nd syntype is a male with the same data as the lectotype. The 3rd specimen examined is labelled as follows: Quop, W. Sarawak, G. E. Bryant, 4-4-16/G. Bryant Col. 1919-147/Conosoma pictum Brnh./Chicago NH Mus. M. Bernhauer Coll.

Remarks. Although I made no effort to study the type material of *E. elegans* Cameron, there can be no doubt about the identity of the species. The single female examined was from the type locality and collected by the same collector as the specimen described by Cameron. The specimens at hand match the excellent description given by Cameron in every respect.

Key to species of *Euconosoma* Cameron

1. Apical segment of antenna piceous; each elytron with large, crescent-shaped black macula extending from scutellum to just behind humeral angle; length 2.9 mm (from front of head to apex of elytra); known from Nepal .... *E. nepalensis* new species

1′. Apical segment of antenna testaceous; each elytron with inner half of basal area and sutural area testaceous, remainder black; length 3.4-3.8 mm (from front of head to apex of elytra); known from Malaysia .... *E. pictum* (Bernhauer)

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* * *

SOME ADVANTAGES OF DOING YOUR OWN DRAWINGS

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An editor once wrote concerning a drawing of ours, "We will use the illustration this time although it is somewhat rough. Next time get a commercial artist to do it for you." We believe his advice unsound.

The drawing, although not as aesthetically pleasing as one done by a commercial artist (or scientific illustrator) was taxonomically and proportionally correct. We feel that the main purpose of a scientific illustration is to give the reader a visual diagnostic picture of the object or subject referred to in the text. No doubt an accurate drawing is worth a thousand words especially to the taxonomist describing complex structures.

Many entomologists are discouraged in their attempts to make drawings of insects because of lack of confidence in their artistic ability. We urge them to make an effort to draw. The experience can be rewarding and perhaps result in a more accurate and useful drawing than can otherwise be achieved. Once confidence is acquired many articles can be illustrated that otherwise might not be illustrated.

Several years ago at the California Academy of Sciences in San Francisco, Hugh Leech showed one of us (IM) the original drawings made by Adelbert Fenyes for his Aleocharinae section of the Genera Insectorum (Fasc. 173A, B, C. 1918-21). Fenyes' drawings were done on quadrille paper, nicely colored, and looked very much like the insects portrayed. They were, however, of a size smaller than desirable for the publication. They are obviously not the illustrations used. It is apparent that the editor engaged a commercial artist to redraw the pictures. The beautifully hand colored plates in that work are obviously the work of a skilled artist. They make an elegant showing; but, unfortunately, they are so badly distorted that many of them only slightly resemble the species they are alleged to represent. Anyone familiar with the insects can verify this at a glance. Fenyes' drawings, although not done with the same craftsmanship, would have served the purpose much better.

One of the greatest advantages of doing your own drawings is that it sharpens the perceptions; details which otherwise were casually noticed must now be concentrated on in order to be properly reproduced. In making one's own drawings those of us who are not too artistically inclined generally begin by making precise checks on drawings of closely related species previously illustrated by other authors. The gross aspect and alignment of the new subject is then made similar to those previously described, lending greater continuity to the illustrations. Minute details are scrutinized, generally yielding a greater understanding of the articulation and perhaps function of the object explored.

The student of a taxon knows best the characters which should be portrayed. It may be, for example, that the shape or proportions of one or several segments of the antennae are the most important taxonomic characters available. The student understands this and makes a special effort to portray this. An untrained artist, even when shown, may not understand the aspect which is of greatest value and consequently make taxonomic errors in the drawings; it is up to the taxonomist to detect these errors and have them corrected. Cost and the availability of an artist are also important factors to be considered.

Some suggestions which may be helpful in drawing insects were given by Anderson (Bio. Science 16:758-759. 1966), Moore (Coleopt. Bull. 28:26. 1974), Orth and Moore (Coleopt. Bull. 28:180. 1974), and Micheli (Coleopt. Bull. 29:74. 1975).

* * *

ACOUSTIC BEHAVIOR OF *TROPISTERNUS ELLIPTICUS*, *T. COLUMBIANUS*, AND *T. LATERALIS LIMBALIS* IN WESTERN OREGON (COLEOPTERA: HYDROPHILIDAE)

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Abstract

Besides the known stridulation in stress, calling, and courtship functional categories, acoustical signals in 2 new categories, male copulation and female aggression (male rejection), are described for the genus *Tropisternus*. Two male positions are recognized during courtship: the forward position and the probing position. *T. columbianus* restricts stridulation to the probing position, whereas the other 2 species stridulate in both positions. All species of *Tropisternus* studied emit stress and calling chirps. *T. ellipticus* also has either male buzzes or slow trills during both probing and copulation. *T. columbianus* has male courtship slow trills. *T. lateralis limbalis* has male ticking during calling, and it has courtship fast trills identical to the subspecies *T. l. nimbatus*. Females of *T. ellipticus* and *T. columbianus* have a similar aggressive signal, the rejection buzz, which terminates courtship by males. Although courtship sounds were emitted during calling, calling sounds were never emitted during courtship.

Introduction

Tropisternus ellipticus, *T. columbianus*, and *T. lateralis limbalis* commonly occur in quiet aquatic habitats of western Oregon. Three functional categories of acoustic signals (Alexander, 1967, 1968) have been described for *Tropisternus*: disturbance (stress) by both sexes, calling by both sexes, and male courtship (Ryker, 1972, 1975b). I here describe acoustic signals in the same categories for these western Oregon species and report 2 new functional categories: male copulation and female aggression (male rejection). Also, 2 male positions are recognized during courtship. The stridulatory apparatus for *Tropisternus* was described previously (Ryker, 1972).

Materials and Methods

Sounds were recorded with an Uher 4000L portable tape recorder at a tape speed of 19 cm/sec (7.5 ips), using a rubber coated clip-on contact microphone completely immersed in the water (Kellogg 1960). Playback for analysis utilized the same recorder, which had a measured frequency response of 0.05-10 kHz +/- 3 db, and a Kay Sona-Graph 6061A, 0.085-8 kHz spectrum analyzer, using the Wide Band Filter for precision in timing measurements. Recording and behavioral observations were carried out in a 8.5 X 16.5 X 6 cm (depth) plexiglas chamber. To dampen sound reflection, the floor and one side wall were covered with 2 layers of asbestos screening oriented at 45° to each other; and the chamber was screen-partitioned into 3 chambers, with one of the end chambers filled with aquatic plants.

Observations were made in the opposite end. The microphone was in the narrow central chamber. Bright incandescent illumination was provided during observations, and the water temperature was held between 22-27°C to allow normal behavior and eliminate temperature effects on sound parameters (Ryker 1976). Student's t-test for unequal sample sizes was used for statistical evaluations of signal parameters.

RESULTS

Courtship Positions

Males of *Tropisternus* used visual cues at close range (1-2 cm) to orient to females (Ryker 1976) and usually mounted the backs of the females immediately upon contact. The male began a rather stereotyped courtship dance while mounted (Young 1958), including stridulation (Ryker 1972) in one or both of 2 courtship positions. The male first oriented head to head, and then moved anteriorly and leaned down over the head of the mounted beetle to touch palpi with it. While in this position, the "forward" courtship position, the male encircled one of her palpi with both of his palpi, which curved slightly backward (Fig. 1a). Then he shifted across to the other side of her head, his palpi dragging across hers until they encircled her second palpus (palpus-touching). Palpus-touching was repeated as the male rhythmically shifted from one side of the female's head to the other. As the male moved from one side to the other, his body pivoted so that his hind leg opposite to the side he was on was free to sweep across the surface of her elytra (hindleg sweeping) (Fig. 1a). The male swept 2 to 4 times per side in all species studied. While positioned forward, some species of *Tropisternus* stridulated some or all of the time; others were silent.

After shifting from side to side at the head several times, the male stepped backwards and probed the female's genital area with his extended aedeagus (probing). Most species studied stridulated in the probing position, but some were sometimes silent. Males mounted in the probing position rhythmically tapped either 1 or both foretarsi on the female's elytra (Fig. 1b). The rate of tapping was different for different species. In *T. columbianus,* for example, males tapped about 4 times per second.

Copulation occurred only if the female permitted it by lowering her abdomen to receive him. Females sometimes began a violent side to side shaking motion, often accompanied by stridulation, as males mounted them. Females also frequently struck at the male's palpi with their forelegs as the males attempted palpus-touching. I interpret female shaking and stridulating as rejection behavior, as it usually terminated courtship.

Tropisternus ellipticus (LeConte)

T. ellipticus occurs throughout the western United States, Mexico, and Central America (Spangler, 1960). In western Oregon this species breeds in temporary pools in the spring and river rock pools in the summer, and overwinters in ponds and lakes (Ryker 1975a).

The stridulations of *T. ellipticus* were separated into 10 types according to sex and behavioral context: 4 male and 2 female chirps, 3 types of male buzzes, and 1 female buzz. Data from measurements of the sounds, including means, standard errors, sample size, and statistical significance, are summarized in Table 1.

Calling chirps of males, when alone or when responding to the sight or acoustical signals of other beetles, and of responding females were similar in duration ($P < 0.05$). However, the male *stress chirp* was of longer duration ($P < 0.05$), and the female stress chirp was even longer ($P < 0.01$) (Table 1) (Fig. 2a, b).

Buzzes (slow stridulations in which the component pulses are distinguishable but too rapid to be counted by ear) may be produced by males when alone, when responding to the sight or stridulations of other beetles, during courtship in the forward position, during probing, and during copulation (Fig. 2c, e). However, males may be silent in each of those contexts. The durations of male buzzes were essentially similar in all contexts ($P < 0.05$)(Table 1). Pulse rates of buzzes of males alone, responding, or in the forward courtship position were similar ($P < 0.05$), and these contexts are combined as "courtship buzz" in Table 1. Male buzzes emitted during probing and copulation are similar in duration to other buzzes, and have

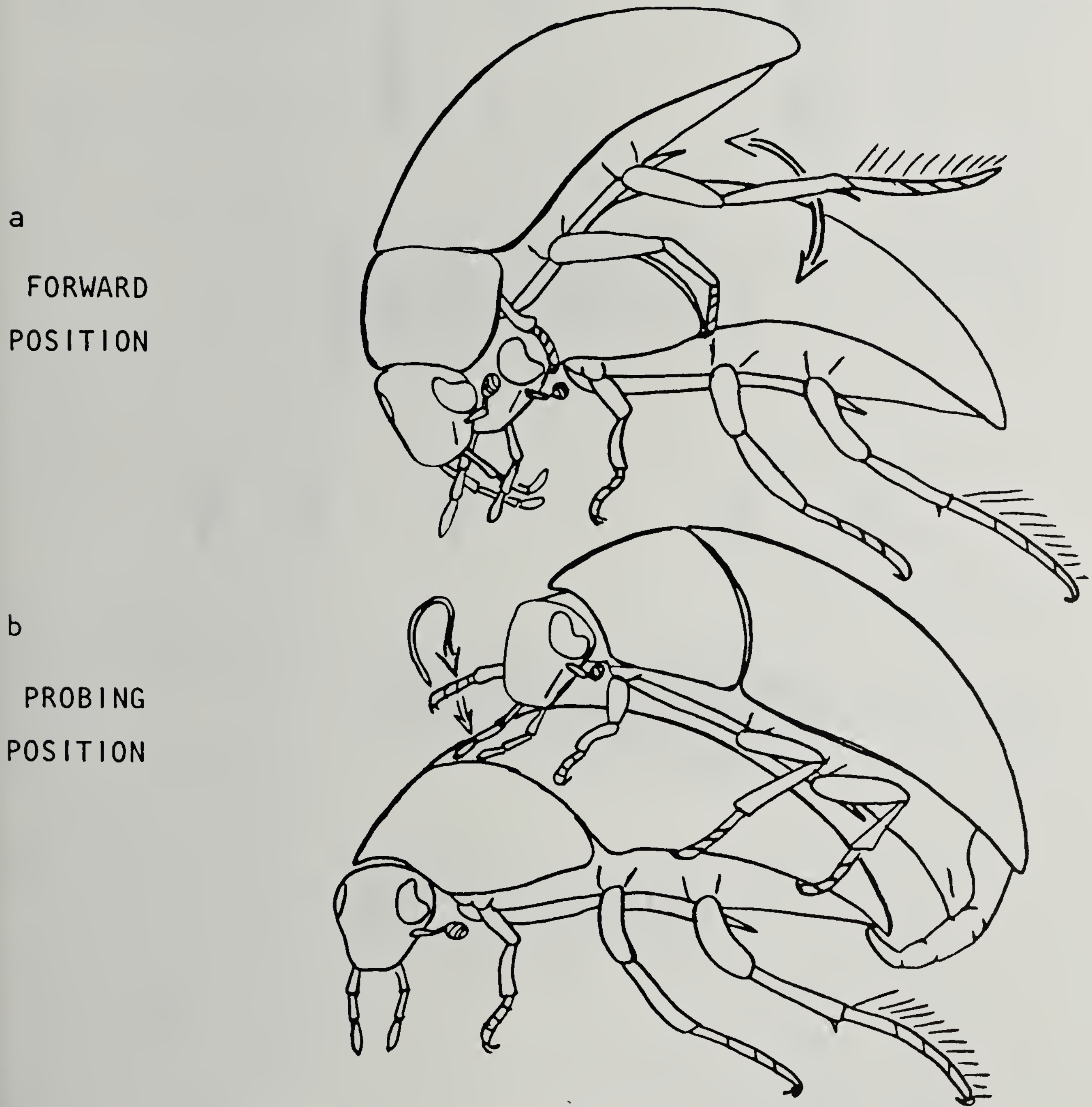

Fig. 1. Courtship positions of *Tropisternus*: a) forward position with palpus-touching and hindleg-sweeping; b) probing position with foreleg-tapping.

pulse rates similar to each other but slightly faster than other buzzes ($P < 0.05$).

Females of *T. ellipticus* sometimes produced buzzes accompanied by rocking or shaking from side to side during courting by males (*rejection buzz*) (Fig. 2f). These were of longer duration and faster pulse rate than male buzzes ($P < 0.05$).

Probing and copulation were occasionally also accompanied by rhythmic chirps (*slow trills*) by the males (Fig. 2d). Slow trills during probing were shorter in duration and slower in chirp rate than slow trills during copulation ($P < 0.05$).

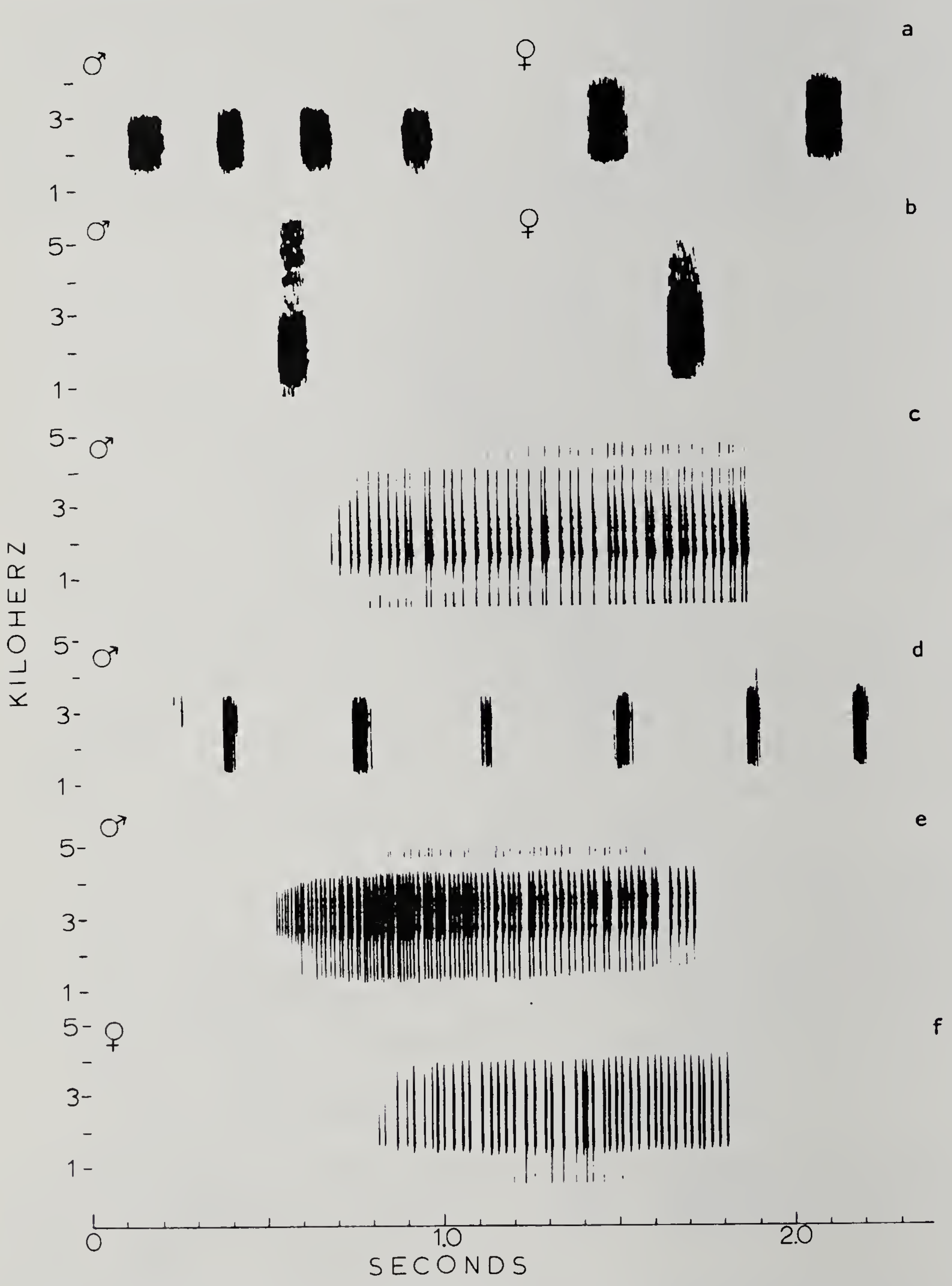

Fig. 2. Sonagraphs of stridulations of *Tropisternus ellipticus*: a) stress chirps (27°, 28°C); b) calling chirps (28°, 27°C); c) buzz, forward position (28°C); d) rhythmic probing chirps (24°C); e) copulation buzz (29°C); f) rejection buzz (28°C).

Tropisternus columbianus Brown

T. columbianus occurs from the west coast of the United States, British Columbia, Canada, and Baja California, Mexico, eastward to the edge of the Great Plains in Michigan (Spangler 1960). In western Oregon this species is found in permanent ponds and lake edges throughout the year.

Table 1. Summary of sound data for Tropisternus ellipticus.

Sound	Duration (seconds)				Pulse rate (pulses/second)			
	$\bar{x}$	SE	n	Stat. signif.	$\bar{x}$	SE	n	Stat. signif.
♂ calling chirp	0.075	0.005	(18)	a[1]				
♀ calling chirp	0.072	0.003	(27)	a				
♂ stress chirp	0.088	0.004	(74)	b				
♀ stress chirp	0.098	0.004	(74)	c				
♀ rejection buzz	1.070	0.073	(20)	d	42.5	1.74	(20)	h
♂ courtship buzz	0.830	0.032	(89)	e	50.0	2.70	(89)	i
♂ probing buzz	0.889	0.099	(13)	e	60.7	6.63	(13)	j
♂ copulation buzz	0.868	0.132	(5)	e	59.0	3.63	(5)	j
					Chirp rate (chirps/second)			
♂ probing slow trills	0.065	0.006	(50)	f	2.5	0.20	(10)	k
♂ copulation slow trills	0.092	0.006	(46)	g	1.95	0.11	(11)	l

Table 2. Summary of sound data for Tropisternus columbianus.

Sound	Duration (seconds)				Chirp rate (chirps/second)			
	$\bar{x}$	SE	n	Stat. signif.	$\bar{x}$	SE	n	Stat. signif.
♂ calling chirp	0.060	0.002	(60)	a[1]				
♀ calling chirp	0.081	0.003	(25)	b				
♂ stress chirp	0.113	0.003	(42)	c				
♀ stress chirp	0.130	0.003	(61)	d				
♂ probing trill	0.123	0.004	(46)	e	2.12	0.093	(46)	f
♂ copulation trill	0.141	0.010	(14)	e	1.71	0.092	(14)	g
♂ unmounted trill	0.127	(one ♂ only)						
					Pulse rate (pulses/second)			
♀ rejection buzz	0.688	0.043	(31)		43.1	4.8	(19)	

Table 3. Summary of sound data for Tropisternus lateralis limbalis.

Sound	Duration (seconds)				Chirp rate (chirps/second)			
	$\bar{x}$	SE	n	Stat. signif.	$\bar{x}$	SE	n	Stat. signif.
♂ calling chirp (alone)	0.082	0.004	(22)	a[1]				
♂ calling chirp (response)	0.155	0.025	(8)	b				
♀ calling chirp (response)	0.172	0.034	(17)	b				
♂ stress chirp	0.106	0.003	(73)	c				
♀ stress chirp	0.102	0.003	(71)	c				
♂ unmounted trill	0.022	0.002	(23)	d	7.8	0.2	(23)	e
♂ courtship trill	0.024	0.001	(63)	d	8.5	0.2	(63)	f
♂ copulation trill	0.023	0.002	(14)	d	8.4	0.4	(8)	f
♂ chirp-trill	0.020	0.006	(23)	d	8.1	0.1	(23)	g
♂ chirp-walk					3.4	0.1	(6)	
					Tick rate (ticks/second)			
♂ ticking	0.803	0.038	(39)		10.8	0.6	(39)	

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[1] different letters in same vertical column indicate significant differences at $P < 0.05$ level.

The stridulations of *T. columbianus* were separated into 10 types according to sex and behavioral context: 3 types of chirp for each sex, 3 types of male trills, and 1 female buzz. Of these, I have no recordings of males or females alone; however, other studies indicate that both sexes chirp when alone (Ryker 1976). Data from measurements of these sounds are summarized in Table 2.

When alone or when responding to acoustic or visual stimuli, both sexes emitted *calling chirps* that were of shorter duration than the *stress chirps* (Fig. 3a, b). Both the calling chirp and the stress chirp of females were longer than the corresponding chirps in males; i.e., there were 4 distinct chirps ($P < 0.05$).

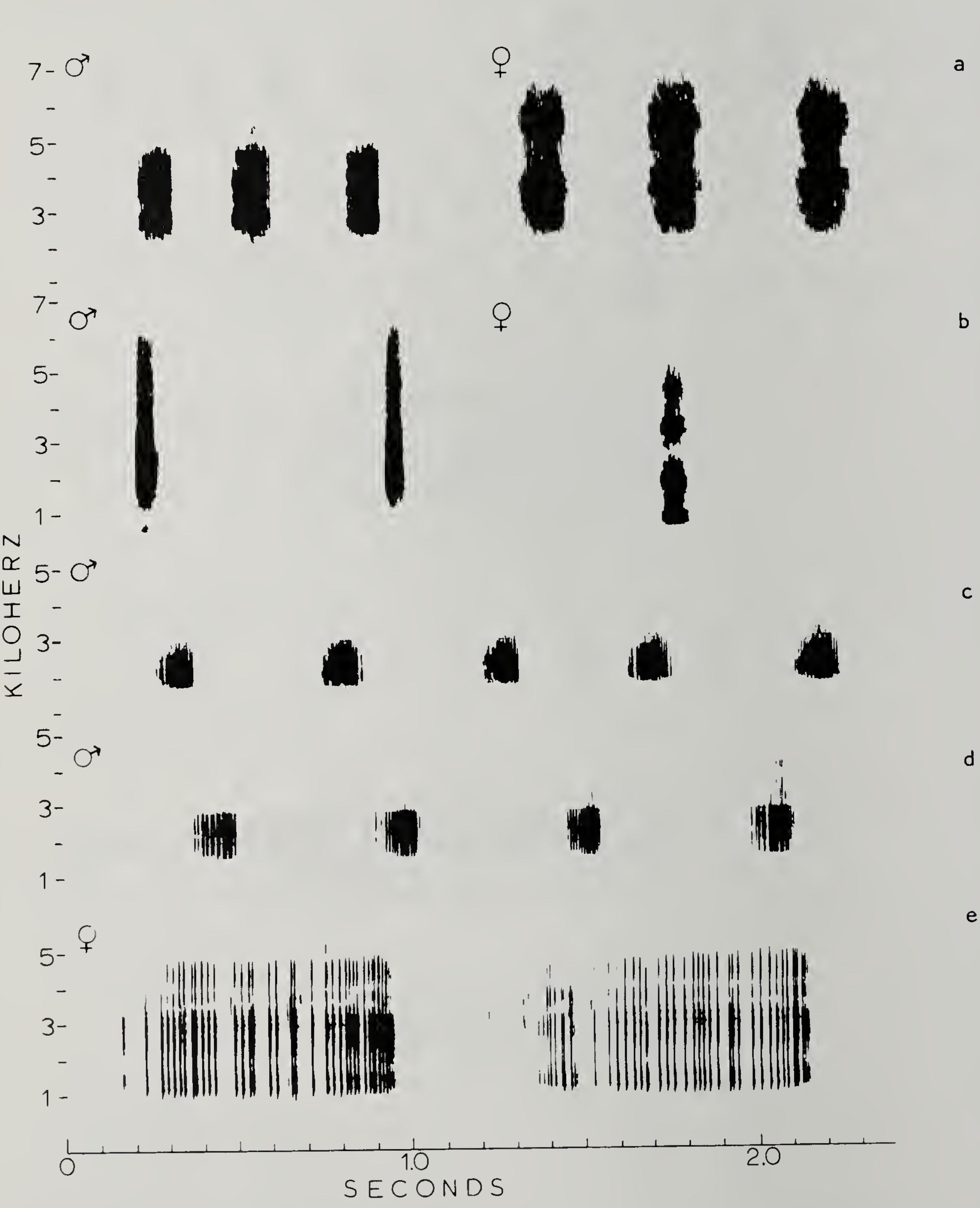

Fig. 3. Sonagraphs of stridulations of *Tropisternus columbianus*: a) stress chirps (26°, 25°C); b) calling chirps (29°, 22°C); c) probing trill (23°C); d) copulation trill (27°C); e) rejection buzz (28°C).

Males trilled or were silent when responding to acoustic or visual stimuli, always trilled during courtship when probing, and rarely during copulation (Fig. 3c, d). Durations of *probing* and *copulation trills* were similar, but the rhythm, or chirp rate, of the probing trill was faster than that of the copulation trill ($P < 0.05$). The trill of an unmounted male was even faster than these 2; but because only 1 beetle was represented in the data, the rate could not be compared statistically.

Females of *T. columbianus* sometimes emitted a *rejection buzz* similar in pulse structure to that of *T. ellipticus* females as they shook and rocked from side to side during male courtship (Fig. 3e). This was the only buzz produced by this species.

Tropisternus lateralis limbalis (LeConte)

This is a montane race of *T. lateralis* that occurs west of Colorado, from British Columbia southward into Central Mexico (Spangler 1960). In western Oregon, this species overwinters in ponds and breeds in temporary pools or pond edges with a soft mud bottom.

The stridulations of *T. l. limbalis* were separated into 13 types according to sex and behavioral context: 3 types of chirps for each sex, 5 male trills, the male chirp-walk, and male ticking. Data from measurements of these sounds are summarized in Table 3.

When alone or when responding to acoustic or visual stimuli, both sexes emitted *calling chirps* (Fig. 4b). The male chirp given when alone was of shorter duration than the other chirps ($P < 0.05$); I have no recordings of solitary females. Sampled response chirps of both sexes were also few in number; however, the ones recorded were longer in duration than male calling chirps when alone. Male *stress chirps* were similar in duration to female stress chirps and longer than male chirps when alone ($P < 0.01$) (Fig. 4a).

Males trilled at times when alone, when approaching to mount another beetle, when mounted at the head, when probing, and sometimes when copulating (Fig. 4c, d). The durations of chirps making up trills were similar for all trills. However, the chirp rate of unmounted trills was slightly faster ($P < 0.05$) than the others. Chirp rates of *courtship trills* in both the forward and probing positions are similar to the chirp rate of *copulation trills* ($P < 0.05$).

Males produced *ticking* sounds at times when alone, particularly after being stimulated by chirping or by visual contact with another beetle (Fig. 4e). Usually the immediate response to such stimulation was to chirp, but in less than a minute a male would switch to ticking if he was not further stimulated. Ticking phrases contained about 8 ticks, ranging between 5 and 13 ticks.

After contacting another beetle, a sexually responsive male often began walking stiff-legged and jerkily and produced a series of small sounds I have termed the *chirp-walk* (not illustrated). Chirp-walking males invariably attempted to mount any beetle-like object coming into visual range. Chirp-walk sounds may be a by-product of the state of excitement of the male as he searches for a female, with no signal value.

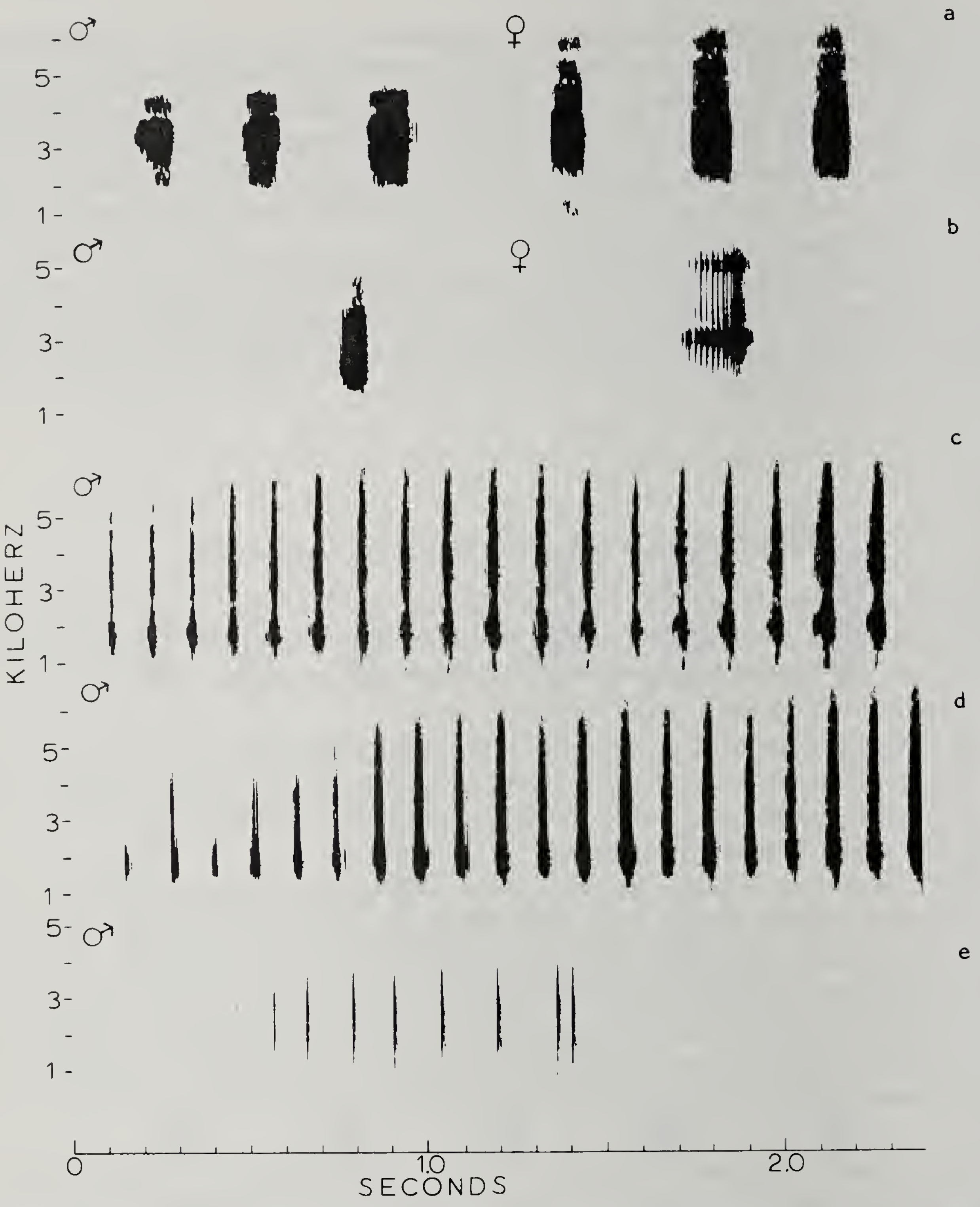

Fig. 4. Sonagraphs of stridulations of *Tropisternus lateralis limbalis*: a) stress chirps (27°C); b) calling chirps (27°, 21°C); c) courtship trill (23°C); d) copulation trill (22°C); e) ticking (23°C).

Discussion

A distinction between the forward and the probing positions during courtship is necessary because a male of *Tropisternus* may restrict stridulation to 1 of the 2 positions. For example, *T. columbianus* generally restricts its slow trill to probing, remaining silent in the forward position. In contrast, *T. ellipticus* stridulates more frequently in the forward position than during probing (Ryker 1976).

Statistical comparisons of signal parameters permit a listing of the number of physically distinct stridulations for each species, although the living beetles may not discriminate between all of these. Six distinct signals are produced by *T. ellipticus*: calling chirps, stress chirps, male buzzes, probing slow trills, copulation slow trills, and the female rejection buzz. Seven distinct signals are produced by *T. columbianus*: male calling chirps, female calling chirps, male stress chirps, female stress chirps, male courtship trills, and the female rejection buzz. Four distinct signals are produced by *T. lateralis limbalis*: calling chirps, stress chirps, male trills, and male ticking.

The calling chirps of the 3 western Oregon species of *Tropisternus* are quite similar in duration. Although the chirp of *T. columbianus* is statistically shorter, the other 2 are not different. The leading edge of the calling chirp of *T. l. limbalis,* however, has a distinctive pulse structure not found in the other 2 species.

In courtship behavior, *T. ellipticus* is the only species of the 3 to have a buzz, and the fast trill of *T. l. limbalis* is distinguishable from the slow trill of *T. columbianus.* Males of *T. ellipticus* sometimes give a similar slow trill during probing, but the duration of each component chirp is only half as long as that of *T. columbianus.*

Ticking sounds of *T. l. limbalis* and "courtship" buzzes of *T. ellipticus* produced in calling situations do not provide signal specificity between these 3 species because the mating sequence frequently begins with mounting by the male upon contact with a female, with no prior signals. Therefore, signals during courtship probably have a more important role in species recognition than have calling signals.

Males of *Tropisternus* may produce several sounds in calling situations, but the calling chirp is never used during courtship. Also, males usually have a single courtship sound (except *T. ellipticus*), but courtship sounds may also be produced during calling and copulation.

Aggressive behavior by females towards courting males has been observed many times in all species studied. Females of *T. mixtus* (Ryker 1972), *T. lateralis nimbatus* (Ryker 1976), *T. ellipticus,* and *T. columbianus* have a characteristic buzz that accompanies other rejection behavior like shaking and striking the male's palpi with forelegs. These buzzes are variable in duration and have similar pulse rates in these 4 species.

Surprisingly; the signaling repertoire of *T. l. limbalis* in Oregon is identical to that of *T. l. nimbatus* in Michigan even in measurements of chirp durations and trill rates, although the Oregon subspecies includes more ticks in each ticking phrase. The slow trills of courting males of *T. columbianus* are distinctive from those of other species. The courtship buzz of *T. ellipticus* is similar to those known in *T. glaber* and *T. natator,* although slower in pulse rate. Signals of sympatric species in Oregon are distinctive, as one would expect. However, the added importance that the present study has led me to place on species recognition during courtship (rather than during calling) brings up the question how females of *T. natator* and *T. glaber* in Michigan, which have extremely similar mounted courtship buzzes (Ryker 1972), select males of their own species. Tactile or chemical signals may play a more important role in this genus than has yet been demonstrated.

ACKNOWLEDGEMENTS

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PLATYSTETHUS SPICULUS ER. (STAPHYLINIDAE) IN FLORIDA

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On 11 January 1975 I discovered a fairly fresh deposit of horse dung in the vicinity of my house, about 5 miles south of Vero Beach, Indian River County, Florida. The dung, placed in a Berlese funnel, produced 45 adults of a species of *Platystethus.* I was unable to distinguish these from examples of a species in my collection from Jamaica and from Haiti. These latter agree well with the description of *P. spiculus* Er. given by Blackwelder (1943), who considered *P. spiculus* to be the only species of the genus present among the material he had examined from the West Indies. I later (27 April 1975) collected 77 examples from a slime mold *Fuligo septica* (L.) Wigger in the same locality and one example (22 May 1975) from chicken guano a few miles north.

P. spiculus is recorded from South and Central America and Mexico, in addition to the West Indies, by Blackwelder (1943), but in the United States only from Texas by Casey (1886) and Arizona and California by Moore and Legner (1971). Despite a brief comparison by Sharp (1887) and a key by Moore and Legner (1971) I was uncertain of the characters distinguishing *P. spiculus* from *P. americanus* Er., which is widely distributed in the United States according to Arnett (1960). Because I had no known examples of *P. americanus* in my collection, I sent 10 of the Florida examples to Lee Herman. He kindly compared them with examples of *P. americanus,* informed me that he did not believe them to be conspecific, and sent me 5 examples of *P. americanus.* After comparison with the latter, I believe that the Florida examples are conspecific with the species believed by Blackwelder (1943) to be *P. spiculus.*

The descriptions of *P. americanus* and *P. spiculus* as given by Moore and Legner (1971) are essentially correct, but further clarification of the characters of the head would be helpful.

In *P. spiculus* the sclerotized postclypeus of the male is centrally emarginate to the level of the antennal ridge and is laterally produced into a pair of slender horns, from 1X to 2X as long as the distance between them; these horns extend anteriorly well beyond the corneous anteclypeus. In the female the sclerotized postclypeus is slightly, broadly emarginate, not nearly as far posteriorly as the antennal ridge, and the emargination produces an effect of 2 short, blunt, triangular horns; these however do not extend anteriorly beyond the margin of the corneous anteclypeus, thus giving the entire clypeus a rounded, protruding appearance.

In *P. americanus* the sclerotized postclypeus of the male is centrally, but not very deeply, emarginate to the level of the antennal ridge and is laterally produced into a pair of sharp, triangular horns not more than 0.25X as long as the distance between them; these horns lie on either side of the rather narrow corneous anteclypeus and thus laterally, but not centrally, protrude beyond its margin. In the female the sclerotized postclypeus is broadly and shallowly emarginate, not nearly as far posteriorly as the antennal ridge, and the emargination is so shallow that the anterior angles of the postclypeus do not give the appearance of horns.

In *P. spiculus* the head of both sexes is finely and sparsely punctate. The male has, on each side of the head, 3 longitudinal sulci between the vertex and the eye, called here respectively (from vertex outwards) central, outer, and ocular. In the female the ocular groove is distinct, the central groove is obsolescent anteriorly, and the outer groove is reduced, sometimes so reduced as to appear absent.

In *P. americanus* the head is coarsely punctate, the punctures tending to become longitudinally confluent, especially laterally. The head has a single longitudinal sulcus at each side, in the position of the ocular sulcus of *P. americanus.*

Females of *P. spiculus* with the outer sulcus so reduced as to be considered "absent" by Blackwelder (1943) and Moore and Legner (1971) will match the very brief description of *P. obscurus* Sharp (1887) from Mexico. This raises the question of possible synonymy of the name *P. obscurus* because no males of that species have, to my knowledge, ever been recognized. I have not seen the holotype of *P. obscurus* and do not know whether it has any other characters distinguishing it from *P. spiculus.*

The food of *P. spiculus* is unknown. On the evidence of the occurrence of adults in *Fuligo septica,* where no other animals were seen, the slime mold itself may provide food.

ACKNOWLEDGEMENT

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NOTES ON THE LIFE HISTORY AND HABITS OF *PERIGASTER CRETURA* (HERBST) (COLEOPTERA: CURCULIONIDAE) WITH DESCRIPTIONS OF THE LARVA AND PUPA[1]

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Abstract

Adults, larvae, and pupae of *Perigaster cretura* (Herbst) occur on species of *Ludwigia* and *Jussiaea* (Onagraceae). Larvae feed externally on the leaves and cover themselves with a protective covering of their own excrement. Pupation occurs on the leaves in a cell formed from a secreted material, excrement, and bits of debris. Larval and pupal stages are described and illustrated.

Several weevils in the subfamily Ceutorhynchinae have larvae which feed externally on the leaves of their host plant and cover themselves with a viscid secretion and their own excrement. These include members of the genera *Coelogaster* (Knab 1915), *Phytobius* (Hoffmann 1954, Scherf 1964) and *Perigaster cretura* (Herbst) (Mitchell and Pierce 1911, Knab 1915, and Pierce 1916). The purpose of this paper is to present observations on the life history and habits of *Perigaster cretura* and to describe the larval and pupal stages of the species.

Life History and Habits

Perigaster cretura (Figs. 1 and 2) is one of 5 species of this New World genus. The genus was revised by Buchanan (1931). Four species, including *P. cretura,* occur in the eastern United States; the 5th species is known only from Panama. Apparently nothing is known about the biology and host plants of the other 4 species of *Perigaster.* The 1st observations on the biology of *P. cretura* were by Mitchell and Pierce (1911), who stated that larvae feed externally on the foliage of *Ludwigia natans* (probably *L. nutans* Ell., Onagraceae) in South Texas. They reported that the larvae exude a sticky substance which apparently aids them in holding onto the leaf. They referred to a "dark shell" which "grows" over the back of the larva, which eventually covers it, and in which pupation occurs. Pierce (1916) amplified these notes, stating that the larvae are yellow in color and "have a gliding motion". He reported that they cover themselves with silk while they feed and that they are usually found under water. He also stated that the pupal cell is composed of silk and a dark substance and is impervious to water. Blatchley and Leng (1916), citing Pierce, repeated this information.

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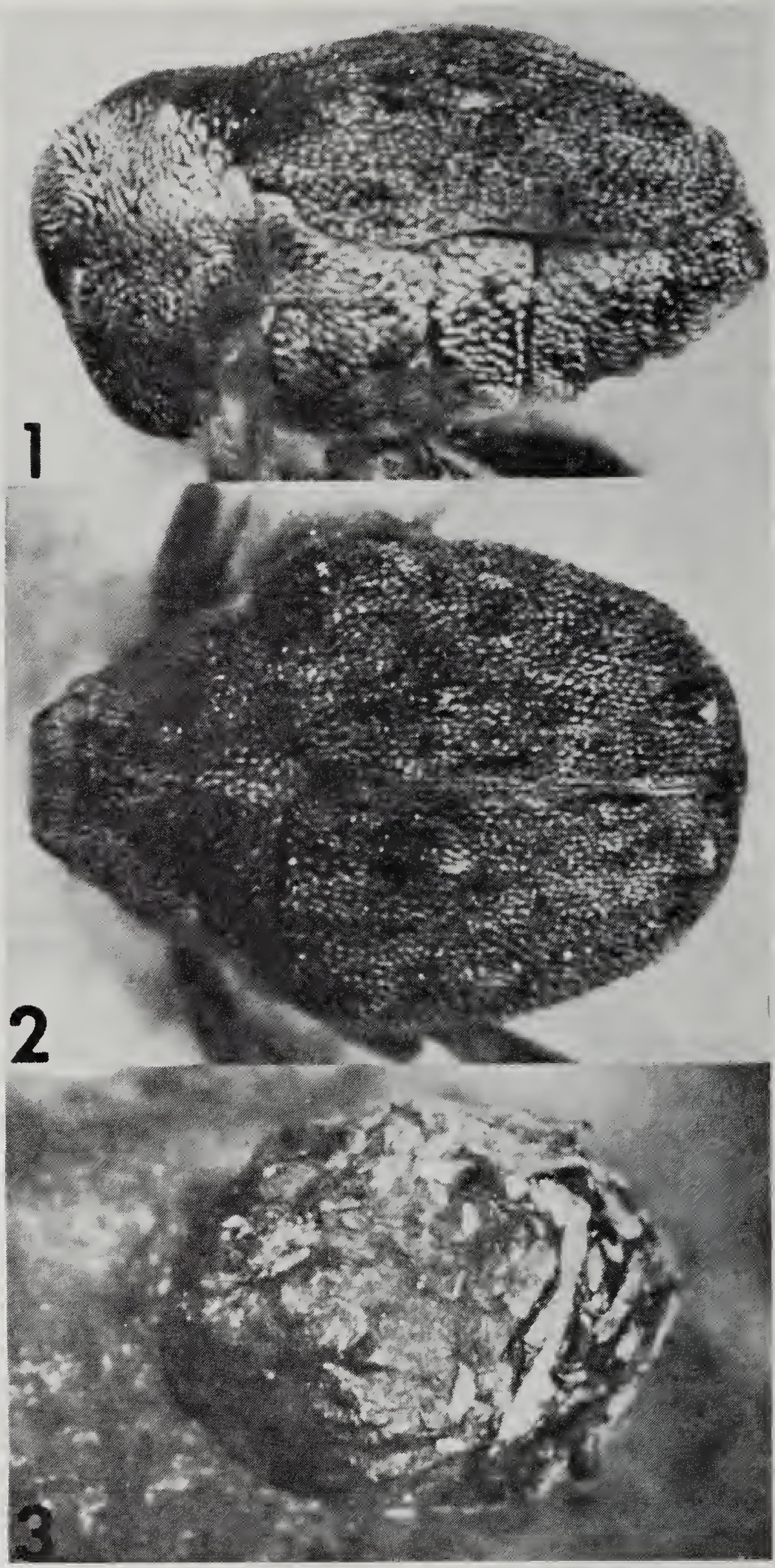


Figs. 1-3: 1-2) Dorsal and lateral aspects of adult male *Perigaster cretura* (Herbst), collected at College Station, Brazos County, Texas, 20-V-1972, by W. E. Clark, on *Jussiaea repens* L. (length: 2.91 mm); 3) Pupal cell of *P. cretura* on leaf of the same plant (length: 3.32 mm).

Knab (1915) had also made observations on this species in Maryland. The species which he observed was identified as *Perigaster obscurus* (LeConte) by Pierce but was subsequently determined to be *P. cretura* (Buchanan 1931). Knab also reported that the larvae feed externally on the leaves of their host plant, in this case *Ludwigia alternifolia* L. He stated that the larvae occurred mainly on the undersides of the leaves and by their feeding made elongate holes in the center portions or cut pieces out of the sides of the leaves. Knab also reported that the larvae cover themselves with excrement imbedded in an anal secretion. He stated that this covering of excrement is transported anteriorly from the anus by "peristaltic movements of the body segments which are particularly violent posteriorly." When the larva is about to pupate, according to Knab, it sheds its covering and shapes it into a cocoon. Knab never actually found pupae in nature, however, and speculated that pupation normally occurs in the ground.

My observations on *Perigaster cretura* on *Jussiaea repens* L. (Onagraceae) were made around the edges of a small pond about 1 mile south of College Station, Brazos County, Texas between 13 May and 22 July, 1972. During the day adult weevils were observed on the upper surfaces of the leaves. They are, as Pierce (1916) observed, saltatorial and take flight at the slightest disturbance. They stridulate when handled. Adults were frequently seen in copula throughout this period, but oviposition and eggs were not observed.

Larvae feed externally on the leaves. Contrary to Knab's report, larvae were most frequently observed on the upper surfaces of the leaves. And contrary to Pierce's report, they were not seen under water even though lower leaves of the plants on which they were feeding were submerged most of the time. Frequently several larvae in different instars were feeding on a single leaf. Larvae confine their feeding activities for the most part to the leaves on the upper portions of the plant. Larvae were usually covered by excrement but on one occasion, when a heavy dew was present on the leaves, larvae were without their protective covering. These larvae were lying motionless in the depression along the midrib of the leaves.

Measurement of larval head capsules indicated that there are 3 larval instars.

Pupal cells (Fig. 3) were also observed on the upper surface of the leaves. Larvae apparently pupate on the leaf on which they had just been feeding. Leaves bearing pupal cells were usually riddled with holes made by feeding larvae. Pupal cells were noted as early as 20 May. On this date all of the cells examined contained mature larvae. Larvae, pupae, and adults were found in cells on leaves on 20 June. Larvae and adults were abundant on the plants on 22 July but no pupae were found on that date. Larvae present at that time were probably part of a 2nd generation.

Weevils were also observed under laboratory conditions. Leaves of the host plant on which larvae were feeding or on which pupal cells had been constructed were placed in petri dishes with a small amount of water. Larvae usually lost their covering of excrement in transport from the field to the laboratory but soon afterwards they began to restore it. From time to time as the larvae fed they flexed the posterior portion of the abdomen anteriorly in a rapid motion and defecated directly onto their backs. The movements of the larva caused the excrement to spread out over the body until it was completely covered.

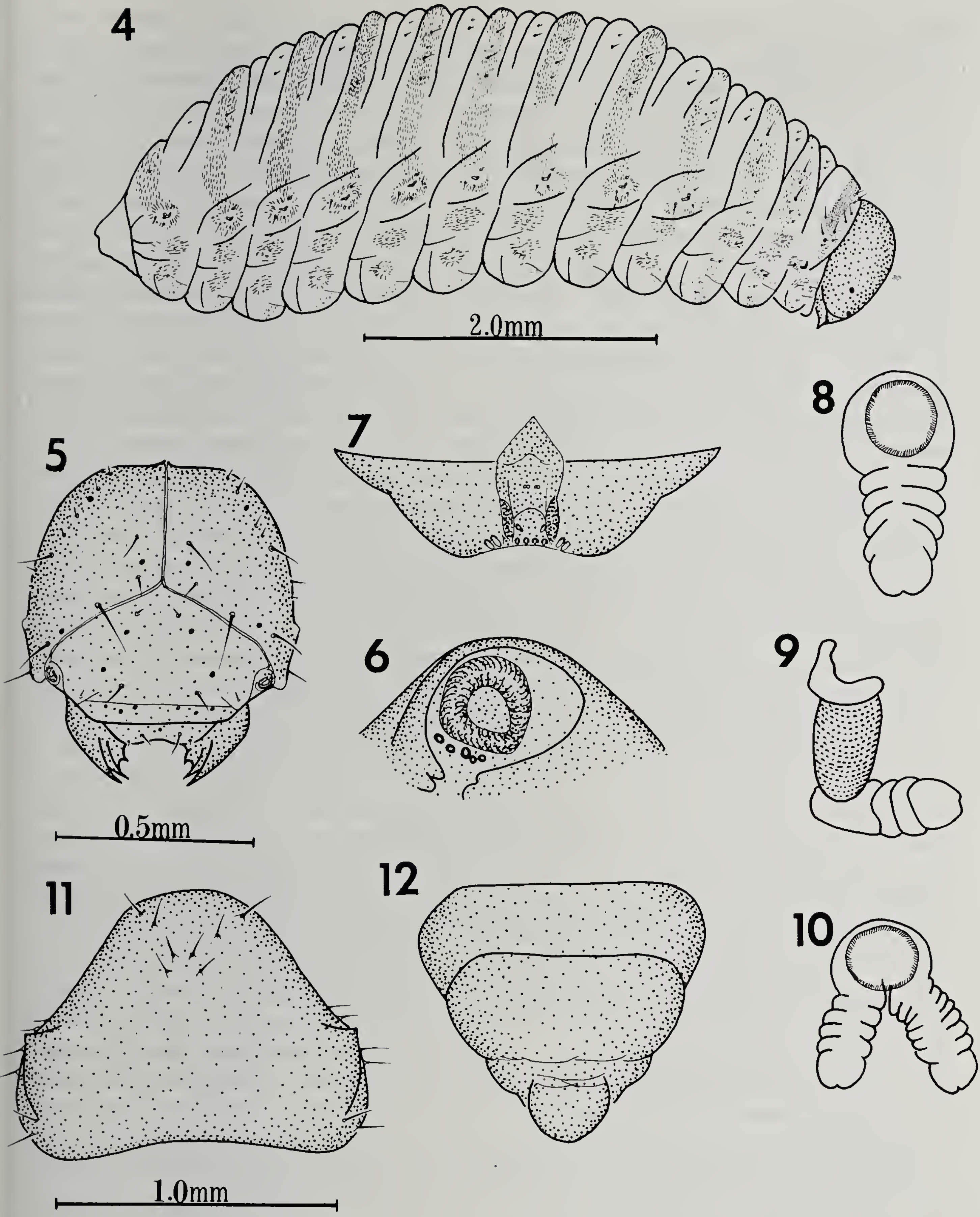
The pupal cell of *Perigaster cretura* (Fig. 3) consists of a thin layer of hard transparent material over which fecal material, bits of plant material, and other debris are added. In addition to the fecal and plant material, some pupal cases had bits of sand, small seeds, and in one instance the cast skin of a cicadellid (Homoptera) nymph incorporated into the matrix. Apparently the larva uses any material it encounters on the leaf for construction of the pupal cell. The small bits of plant material are probably parts of the leaf itself. There was no evidence that the larvae ever leave the leaf to gather material for construction of the cell. In many cells the layer of fecal material and debris did not completely cover the exposed transparent layer.

The hard transparent layer appears to be formed, in part at least, from the viscid material which always covers the larva. There is no silk incorporated in the construction of the cell, despite Pierce's (1916) report. One pupal cell brought into the laboratory contained a mature larva. This larva soon exited from the cell by chewing a hole through the wall. Soon afterward it constructed a new cell by chewing off pieces of the old cell and depositing the material directly onto its back. The movements of the larva caused this material to move posteriorly and eventually through accumulation the larva was entirely covered.

The pupal stage lasted about 1 week in the laboratory. The adult weevil emerges through a hole which it chews in the upper portion of the cell.

Description of Third Instar Larva

The terminology of setae and other structures follows Anderson (1947). *Body*: (Fig. 4) robust, feebly curved, thorax strongly narrowed anteriorly, becoming much narrower than abdomen; length, 4.2-6.0 mm (9 larvae); shining, pale yellow, with dense, fine seta-like asperities on pronotum, postdorsum, and spiracular, epipleural, and pleural areas; asperities often longer than short setae; pedal and eusternal areas with very small, acute asperities. *Head*: (Fig. 5) width, 0.61-0.68 mm, (18 larvae) subequal to length; free, uniformly light yellowish brown, rounded posteriorly. Anterior and posterior ocelli present; anterior ocellus usually with subcutaneous pigment. Antenna (Fig. 6) with accessory appendage modified to form a large ring with a median crater; with 5 smaller posterolateral rings. Catapophyses prominent. Frontal suture narrow, distinguishable throughout its entire length, incomplete anteriorly; endocarina absent. Frons with 3 pairs of setae; frontal seta 1 short, setae 2 and 3 absent, seta 4 long, seta 5 minute; 2 pairs of frontal sensilla present, 1 pair anterior to frontal seta 1, the other lateral and posterior to seta 4. Dorsal epicaranium with 5 pairs of setae; setae 1, 2, 4 and 5 long, seta 3 short. One pair of sensilla located between dorsal epicranial setae 4 and 5; another pair of sensilla located between setae 1 and 3. Lateral epicaranial seta 1 minute, lateral epicaranial seta 2 long. Ventral epicranium with 2 short setae. Clypeus much wider than long, with 2 pairs of minute setae and 1 median sensillum. Labrum with 2 pairs of setae; labral seta 1 large, stout, labral seta 2 minute, labral seta 3 absent; medium labral sensillum present, lateral sensilla absent. Anterior margin of labrum broadly emarginate. Epipharynx (Fig. 7) with 4 large, blunt anterolateral setae, 4 very short indistinct anteromedian setae with large distinct setal bases, and 2 short, stout median



Figs. 4-12, Larva and pupa of *Perigaster cretura*: 4) larva, lateral view; 5) head capsule of larva, dorsal view; 6) antenna of larva; 7) epipharynx of larva; 8) larval thoracic spiracle, lateral view; 9) larval thoracic spiracle, dorsal view; 10) larval eighth abdominal spiracle, lateral view; 11) pronotum of pupa, dorsal view; 12) abdomen of pupa, ventral view.

spines; with 2 clusters of epipharyngeal sensory pores with 2 pores each. Labral rods short, stout, widely separated. Mandible short, stout, with 2 long and 1 short apical teeth; larger teeth with blunt serrations on inner margins; with 2 minute lateral setae and 1 sensillum. Maxillary palpus with 2 articles: basal article with 1 short lateral seta and 2 sensilla; apical article without setae, with 1 sensillum and apical cluster of minute papillae; stipes with 4 setae on ventral surface, setae 1, 3, and 4 long, seta 2 minute; mala with 4 dorsal and 5 ventral setae, 2 of the ventral setae short and blunt, closely set adjacent to each other, remaining 3 ventral setae long, acuminate; dorsal setae all long, acuminate. Labial palpus, single article with 2 sensilla and an apical cluster of papillae. Premental scerite incomplete, lacking posteromedian extensions; with 1 pair of long premental setae (1 member of a second pair sometimes present) and 1 pair of sensilla; glossa with 4 minute median setae and 2 sensilla. Postmental seta 1 short, located just posterior to postmental seta 2; postmental seta 2 long, seta 3 short. *Thorax*: pronotum with elongate dorsal median sclerotized plate; with 10 or 11 long setae (setae described on one side of body only). Thoracic spiracle (Figs. 8 and 9) unicameral, with 4 or 5 annuli and with an elongate, densely, minutely rugose tube arising from peritreme. Prodorsum of mesothorax and metathorax with 2 short setae. Postdorsum of mesothorax and metathorax with 4 setae; setae 1 and 3 long, setae 2 and 4 minute. Alar area with 1 minute seta. Spiracular area of mesothorax and metathorax with 1 minute seta. Epipleurum of mesothorax and metathorax with 2 moderately long setae. Pleural area of prothorax with 2 long setae and with 3 minute setae located along the extreme anterior edge; pleural area of mesothorax and metathorax with 1 long and 1 short seta. Pedal area of each segment with 2 short setae. Sternal seta minute or absent. *Abdomen*: spiracles on segments 1-7 unicameral, spiracle on segment 8 bicameral (Fig. 10); spiracles with long tube arising from peritreme as in thoracic spiracle. Typical abdominal segments each with 3 dorsal folds; fold III shorter than folds II and IV. Typical abdominal segments each with 1 minute and 1 moderately long prodorsal setae and with 2 long and 2 minute postdorsal setae; postdorsal setae 1 and 3 long, setae 2 and 4 minute, shorter than seta-like asperities on postdorsum. Spiracular seta 1 absent, seta 2 minute. Epipleurum with 1 long seta and 1 minute seta. Pleurum and pedal areas each with 1 minute seta; eusternum with 2 minute setae. Sternellum present. Anus terminal.

Material Examined: 23 third-instar larvae (5 slide mounted and 18 whole specimens), College Station, Brazos County, Texas, 13 and 20 May, 1972, from leaves of *Jussiaea repens,* Wayne E. Clark, collector. Determined by association with reared adults.

DESCRIPTION OF PUPA

Terminology follows system developed by Burke (1968) for pupae of the weevil tribe Anthonomini insofar as applicable. *Color*: whitish. *Rostrum*: 1 pair of distirostral setae located at about middle of rostrum; each seta borne on summit of very small tubercle; length of seta much less than ½ width of rostrum. One pair of basirostral setae located on lower anteromedian margin of eye; each seta borne on summit of short rounded tubercle; setae about the same length as distirostrals but separated from each other by distance much greater than distance separating distirostrals. Frontal setae each borne on summit of short round tubercle; tubercles separated by distance distinctly greater than length of a frontal seta. Superorbital setae borne on slightly smaller tubercles located adjacent to dorsal margin of eye. *Pronotum*: (Fig. 11) pronotal setae finely attenuate, slightly curved, each borne on summit of low round tubercle. Four pairs of anterolateral setae arranged in straight line extending diagonally from anterolateral margin of dorsum towards posterior ventrolateral portion of pleuron. Anteromedian setae widely separated. Discal setae located just posterior to anteromedian setae, slightly closer together than anteromedians. Two pairs of posteromedian setae located immediately posterior to discal setae; anterior most pair of posteromedians separated by distance slightly less than length of a setae; posterior pair of posteromedians more widely separated. Two pairs of posterolateral setae located just lateral and posterior to large posterolateral tubercle of pronotum. *Mesonotum and Metanotum*: devoid of setae. *Abdomen*: terga each with 1 pair of discotergal setae and 1 pair of laterotergal setae; setae minute, straight, each seta borne on summit of very small round tubercle. Segment 9 (Fig. 12) bluntly rounded at apex, devoid of setae or processes. Abdominal sterna devoid of setae. *Legs*: each femur bearing a pair of short fine setae on outer face near apex.

Material Examined: 1 pupa, reared from larva collected at College Station, Brazos County, Texas, 20 May, 1972, on foliage *Jussiaea repens,* W. E. Clark, collector. Determined by association with reared adults.

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BOOK REVIEW

A dictionary of entomology, by A. W. Leftwich. 1976. Crane Russak & Company, Inc., 347 Madison Avenue, New York, N. Y. 10017. Hardbound, 360 p., $17.50.

This volume has been prepared for amateur entomologists, naturalists, and zoology students. There are more than 4000 "definitions" which for the most part cover species, genera, and families of insects. Although most of the references apply to European species, a substantial number are American. The text is easy to read and contains many interesting facts. One reads of the "bloody-nosed beetle" (*Timarcha tenebricosa*) which gives off a red fluid from its mouth when disturbed and of the Goliath beetle (*Goliathus giganteus*) of Africa which is more than 11 cm long. A classification of insects is included at the end of the book; the American reader may find some unfamiliar taxonomic names, i.e. order Cheleutoptera (stick insects and leaf insects) and family Necrophoridae (burying beetles). This book should be an excellent addition to the shelves in high school, college, and municipal libraries, but it will be of limited value to the professional (or serious amateur) entomologist. It can not be considered a replacement for the classic—*A Glossary of Entomology.*

—Paul P. Shubeck

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BOOK NOTICES

A glossary of entomology (Smith's "An explanation of terms used in entomology"), Fourth Printing, completely revised and rewritten by J. R. de la Torre-Bueno. 1973. New York Entomological Society (distributed by Hafner Service Agency—A Division of Macmillan Publishing Company, Inc., 866 Third Ave., New York, N. Y. 10022). Hardbound, 336 p., plus IX Plates, and Supplement A, 36p., $10.00.

Ecology and evolution of communities, edited by Martin L. Cody and Jared M. Diamond. 1975. Belknap (Harvard University Press), Cambridge, Mass. Hardbound, 544 p., illus., $29.50.

—Paul P. Shubeck

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LECTOTYPE DESIGNATIONS IN THE MANNERHEIM COLLECTION OF BUPRESTIDAE AT THE UNIVERSITETETS ZOOLOGISKA MUSEUM, HELSINGFORS, FINLAND

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Through the kindness of Dr. H. Silfverberg, the Buprestidae in the Mannerheim collection, Universitetets Zoologiska Museum, Helsingfors, Finland, were sent in order that lectotypes might be designated where appropriate. Lectotype labels have been attached to each. The / mark separates data on individual labels, and my notations are in parentheses with the abbreviations (h) = handwritten and (p) = printed.

Acmaeodera scalaris Mannerheim, 1837:25. 3 labels: female sign (h) / Sommer (h) / Mexico, Mineral del Zimapan (h) /. (Lectotype is a male).

Acmaeodera impluviata Mannerheim, 1837:26. 3 labels: female sign (h) / Sommer (h) / Mexico, Oaxaca. (h) /. (Lectotype is a male).

Pristiptera subsimilis Mannerheim, 1837:42. 3 labels: male sign (h) / Hummel (p) / Brasilia (h) /.

Pristiptera iridea Mannerheim, 1837:42. 3 labels: female sign (h) / Ménétr. (p) / Brasilia (h) /. (Two segments of right antenna and 8 of left present, protarsi and right metatarsus absent).

Psiloptera tuberculata Mannerheim, 1837:46. 3 labels: male sign (h) / Ménétriés (h) / Brasilia, Min. Geraës. (h) /.

Psiloptera wurtembergii Mannerheim, 1837:49. 3 labels: female sign (h) / Hummel. (p) / St. Domingo (h) /. (Lectotype length 20.5 mm; width 8.0 mm).

Psiloptera seriata Mannerheim, 1837:50. 4 labels: female sign (h) / Henning. (p) / Siberia (h) /. B. cyanitarsis ? Falderm nn igitur e Brasilia? (h) /. (This species occurs in Brazil).

Psiloptera pilosomaculata Mannerheim, 1837:46. 3 labels: female sign (h) / Ménétriés (h) / Brasilia, Min. Geraës. (h) /.

Psiloptera auriflua Mannerheim, 1837:45. 4 labels: female sign (h) / Kieber (h) / Brasilia (h) / gold metal square /. (Lectotype length 25.0 mm; width 10.5 mm. Ten segments of left antenna missing).

Buprestis langii Mannerheim, 1843:237. 3 labels: female sign (h) / Blaschke (h) / Sitka (h) /.

Melanophila luteosignata Mannerheim, 1837:70. 3 labels: female sign (h) / Leconte (h) / Amer. bor. (h) /.

Melanophila immaculata Mannerheim, 1837:70. 3 labels: male sign (h) / Leconte (h) / Amer. bor. (h) /.

Melanophila chrysoloma Mannerheim, 1837:72. 5 labels: female sign (h) / Bescke. (p) / Brasilia, Min. Geraës. (h) / blank silver square / an MELANOPHILA *inflammata*? Chevrol. (h) /.

Melanophila prasina Mannerheim, 1837:73. 3 labels: female sign (h) / Bescke (p) / Brasilia, Min. Geraës, (h) /.

Chrysobothris rugosa Mannerheim, 1837:74. 2 labels: male sign (h) / Dalm. (p) /. (Lectotype is a female. Left metatarsus and 3 segments of right metatarsus missing. No locality label).

Chrysobothris fraterna Mannerheim, 1837:75. 5 labels: female sign (h) / Sommer (h) / Moritz (h) / Porto Rico (h) / sub nomine: *C. impressa* Fabr. *serripennis* Dej. mixta (h) / var. praeced. sec. Erickson (h) /.

Chrysobothris seximpressa Mannerheim, 1837:76. 3 labels: male sign (h) / Dejean (p) / Cayenne (h) /. (Only 2 segments of left antenna present, right metatarsus absent. The form of the last visible abdominal sternite indicates the lectotype is a female).

Chrysobothris cribraria Mannerheim, 1837:77. 4 labels: male sign (h) / Dejean (p) / Amer. bor. (h) / an C. *germari*? Laporte et Gory (h) /. (Lectotype is a female. Last 6 segments of right antenna and left metaleg missing).

Chrysobothris (Actenodes) bellula Mannerheim, 1837:79. 3 labels: female sign (h) / Jaeger. (p) / St. Domingo (h) /.

Chrysobothris (Actenodes) fulgurata Mannerheim, 1837:80. 3 labels: male sign (h) / Falderm. (p) / Mexico (h) / . (Lectotype length 19.0 mm; width 7.5 mm. Nine segments of left antenna missing).

Stigmodera carinata Mannerheim, 1837:33. 3 labels: female sign (h) / Ménétriés (h) / Brasilia, Min. Geraës. (h) /.

Stigmodera auricollis Mannerheim, 1837:34. 3 labels: male sign (h) / Ménétriés (h) / Brasilia, Min. Geraës. (h) /. (Three segments of right antenna and 3 segments of left metatarsus missing).

Stigmodera lebasii Mannerheim, 1837:35. 3 labels: male sign (h) / Dejean (p) / St. Fé di Bogota (h) /.

Hyperantha menetriesii Mannerheim, 1837:99. 3 labels: male sign (h) / Hummel. (h) / Brasilia, Min. Geraës (h) /.

Hyperantha sanguinosa Mannerheim, 1837:101. 3 labels: female sign (h) / Ménétriés (h) / Brasilia, Min. Geraës. (h) /.

Stenogaster nubila Mannerheim, 1837:104. 2 labels: Dejean. (p) / Nova Granada, St. Fé di Bogota. (h) /. (Three segments of left mesotarsus, and most of right metatibia and tarsus missing).

Stenogaster murina Mannerheim, 1837:105. 2 labels: Bescke. (p) / Brasilia, interior (h) /. (Left proleg missing).

Agrilus caudatus Mannerheim, 1837:108. 2 labels: Hummel. (p) / Brasilia (h) /.

Agrilus acutipennis Mannerheim, 1837:109. 2 labels: Leconte. (h) / Amer. bor. (h) /. (Lectotype is a male with 7 segments of right antenna missing).

Agrilus argutulus Mannerheim, 1837:109. 2 labels: Dejean (p) / Buenos Ayres (h) /.

Brachys floccosa Mannerheim, 1837:118. 2 labels: Sommer (h) / Mexico, Oaxaca (h) /.

Brachys alboguttatus Mannerheim, 1837:120. 2 labels: Zimmerm. (h) / Pennsylvania (h) /.

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BIOLOGICAL NOTES AND NEW LOCALITIES FOR THREE RARE SPECIES OF NORTH AMERICAN TROGOSITIDAE (COLEOPTERA)

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Abstract

Biological notes and new localities are given for *Cylidrella championi* Wickham, *C. mollis* (Sharp) and *Euschaefferia mclayi* (Van Dyke) (Coleoptera: Trogositidae), all associated with bark beetles (Scolytidae).

During several years of field work on North American Scolytidae, I have collected several specimens of 3 rare species of Trogositidae: *Cylidrella championi* Wickham, *C. mollis* (Sharp), and *Euschaefferia mclayi* (Van Dyke). Because of their subcortical habitat, adults are infrequently collected and consequently biological information is totally lacking. These notes are presented to make future collectors aware of the habits of these species.

The specimens are in the Canadian National Collection of Insects except that 2 specimens each of *C. championi* and *C. mollis* are in the Museum of Comparative Zoology. I wish to thank J. R. Barron, Biosystematics Research Institute and J. F. Lawrence, Museum of Comparative Zoology, Harvard University for their assistance in identifying the species of *Cylidrella,* and D. H. Kavanaugh, California Academy of Sciences, San Francisco for sending several paratypes of *E. mclayi.* I appreciate the assistance of J. R. Barron and E. C. Becker in reading and criticizing the manuscript.

Cylidrella championi Wickham

Barron (1971) examined 7 specimens of this species from Colorado and New Mexico. The specimens were reported as "bred" or "collected" from *Picea engelmanni* (Engelmann Spruce). Schaeffer (1918) reported the species from Arizona but gave no locality data. Recently adults were collected at 3 localities in Arizona. Three were taken at Hannagan Camp, Greenlee Co., Arizona on 12 July 1968 from *Pseudotsuga menziesii* (Douglas fir). Four more were collected at Mt. Lemmon, Santa Catalina Mtns., Arizona on 13 July 1974 from *Pinus leiophylla* (Chihuahua Pine) (1) and *Abies lasiocarpa* (Alpine fir) (3). One was taken at Rustler's Park, Chiricahua Mtns., Cochise Co., Arizona on 26 July 1974 from *Pseudotsuga menziesii.*

Three specimens from Mt. Lemmon were taken under the bark of a small, standing, nearly dead, Corkbark fir (*Abies lasiocarpa* var. *arizonica*) just below the summit of the mountain, in galleries of *Phloeotribus puberulus* (LeC.) and in galleries of a species of *Pityophthorus.* The specimen from *Pinus leiophylla* at the same locality was taken in galleries of a *Pityophthorus* species under the bark of a small, standing pine apparently killed by a blister rust.

Cylidrella mollis Sharp

This species was known previously only from Guatemala. Three specimens were collected at Yerba Buena, 20 miles north of Bochil, Chiapas, Mexico on 10 June 1969 from *Quercus* sp., in galleries of *Pseudopityophthorus granulifer* Wood.

Euschaefferia mclayi (Van Dyke)

Only one specimen other than the type series was seen by Barron (1971) and this specimen was from the same locality as the types. This species was known only from Westwood Hills, Los Angeles Co., California associated with the scolytid *Pseudothysanoes bartoni* Bruck. Two specimens were recently collected in Oak Creek Canyon, 6 miles north of Sedona, Arizona, 2 August, 1974 in galleries of *Pseudothysanoes spinura* Wood. These were found in dead branches of an undetermined, low shrub growing on the east-facing wall of the canyon just above the highway.

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THE LEPTURINE GENUS *PSEUDOTYPOCERUS* (COLEOPTERA: CERAMBYCIDAE)

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Abstract

Four new species are described in the previously monotypic genus, *Pseudotypocerus.* These are: *P. nitidicollis,* El Salvador; *P. virescens,* Panama; *P. inflaticollis,* Panama; and *P. cantharidis,* Costa Rica and Panama.

The genus *Pseudotypocerus* Linsley and Chemsak (1971) was proposed originally to accommodate the Central American *Ophistomis rufiventris* Bates. Subsequently, additional representatives of the genus have become available, including 4 undescribed species. Judging from this material, *Pseudotypocerus* is a genus centering in Central America, and is particularly well represented in Panama.

This study was supported by the National Science Foundation (Grant GB-BM574) for a monograph of the North American Cerambycidae. Authorities at the following institutions and collections are acknowledged for the loan of specimens from collections in their care: University of Arkansas, Fayetteville; Essig Museum of Entomology, University of California, Berkeley; California Academy of Sciences, San Francisco; Florida State Collection of Arthropods, Gainesville; Field Museum of Natural History, Chicago; H. F. Howden, Ottawa; National Museum of Natural History, Washington, D. C.

Genus *Pseudotypocerus* Linsley and Chemsak

Pseudotypocerus Linsley and Chemsak, 1971, Arq. Zool., 21:34.

Description: Form rather short, robust; elytra broad at base, tapering posteriorly to apices, sides straight or slightly narrowed at middle. Head with front rather long, rectangular; palpi unequal, last segment of maxillary pair elongate, cylindrical; neck very abruptly constricted immediately behind eyes, tempora almost absent; antennae slender, shorter than body, inserted on front away from eyes, outer segments slightly thickened, first 5 segments shining, setose, segments from 6th opaque, poriferous areas distinct, usually reduced in females, 3rd segment longer than 1st, 4th equal to 1st, 5th equal to 4th. Pronotum campanuliform, sides slightly sinuate, disk convex; basal angles acute, extending over humeri; apex usually lightly impressed; prosternum not excavated, coxal cavities closed or slightly open behind; mesosternal process broad, curved anteriorly. Elytra moderately attenuated at apices, slightly dehiscent; apices obliquely, narrowly emarginate, angles often dentate. Legs slender; front tibiae densely gold pubescent internally; posterior tarsi elongate, longer than tibiae, 1st segment longer than following 2 together, 3rd segment slender, cleft at least to apical 1/3; claw-bearing segment elongate. Abdominal segmentation normal; last sternite neither deeply impressed nor expanded.

Type species: *Ophistomis rufiventris* Bates (by original designation).

This genus is characterized by the rather short, relatively robust and tapering form, generally short antennae with poriferous areas on the opaque outer segments, almost square face, lack of development of the tempora, and campanuliform pronotum with acute basal angles extending over the humeri. Females are difficult to separate from those of *Strangalia,* but the latter may be distinguished by the differently shaped face, longer pronotum, and excavated prosternum.

KEY TO THE SPECIES OF *Pseudotypocerus*

1. Pronotum rather coarsely, separately punctate, punctures dense or very sparse 2
1′. Pronotum finely very densely punctate, punctures confluent 4

2(1). Pronotum densely punctate, punctures larger than those at base of elytra 3
2′. Pronotum very sparsely punctate and pubescent, punctures subequal to those at base of elytra; abdomen sparsely punctate, pubescence short, sparse. Length, 14 mm. El Salvador .... *nitidicollis,* n.sp.

3(2). Elytra with pubescence appearing golden in oblique light; head with front measured from bases of genae to base of labrum as long as width across genae. Length, 10-13 mm. Mexico to Nicaragua .... *rufiventris* Bates
3′. Elytra with pubescence black under oblique light; head with front broader across genae than length from bases of genae to base of labrum. Length, 14 mm. Panama .... *virescens,* n.sp.

4(1′). Pronotum inflated, abruptly narrowed at apex, antennae densely clothed with short golden pubescence from 6th segment; elytra black, pronotum and scutellum orange. Length 11-15 mm. Panama .... *inflaticollis,* n.sp.
4′. Pronotum moderately convex, gradually narrowing to apex; antennae with outer segments finely dark pubescent; elytra orange, usually narrowly black tipped, pronotum orange, scutellum black. Length, 13-16 mm. Costa Rica and Panama .... *cantharidis,* n.sp.

Pseudotypocerus nitidicollis Chemsak and Linsley, **new species**

Female: Moderate sized, robust, strongly tapering posteriorly; integument reddish, head, antennae, apex and 2 lateral patches of pronotum, prosternum, front and middle coxae, tarsi, tibiae, apices of femora, and apex of abdomen black, elytra dark infuscated from apex, along margins and up suture to about basal 1/3. Head with front measured from bases of genae to base of labrum as long as width across genae; labrum yellow at apex, sparsely punctate; frons densely punctate except for large median triangle; vertex finely contiguously punctate with a few larger punctures interspersed; pubescence very sparse; antennae extending to 3rd abdominal segment, segments from apex of 5th opaque, bearing small apical poriferous pits. Pronotum moderately strongly convex, apex narrowly impressed;

disk shining, very sparsely punctate, each puncture bearing a short depressed dark hair; prosternum vaguely punctate at middle; meso- and metasternum finely, densely punctate anteriorly, more coarsely and sparsely posteriorly, pubescence short, golden, depressed. Elytra about 2½ times as long as broad; basal punctures separated, as large as those on pronotum; pubescence short, dark, depressed; apices obliquely emarginate. Legs slender; hind tarsi with 1st segment slightly arcuate. Abdomen sparsely punctate and pubescent; last sternite very shallowly impressed at apex, angles dentate; last tergite with apex barely notched at middle. Length, 14 mm.

Holotype: female (National Museum of Natural History) from Volcan de Conchagua, La Union, El Salvador, 27-29 May 1958 (O. L. Cartwright).

The shining, very sparsely punctate pronotum is thus far unique to this species.

Pseudotypocerus rufiventris (Bates)

Ophistomis rufiventris Bates, 1872, Trans. Ent. Soc. London, 1872:183; Bates, 1880, Biologia Centrali-Americana, Coleoptera, 5:39, pl. 4, fig. 19.
Pseudotypocerus rufiventris, Linsley and Chemsak, 1971, Arq. Zool., 21:34.
Ophistomis pubipennis Bates, 1885, Biologia Centrali-Americana, Coleoptera, 5:279; Chemsak, 1964, Jour. Kansas Entomol. Soc., 40:78.

Male: Form strongly tapering; color black, prothorax and underside often partially reddish. Head with vertex coarsely, densely punctate; antennae with poriferous areas from segment 6. Pronotum moderately strongly convex, apex narrowly impressed; disk rather coarsely, irregularly, densely punctate; median glabrous line vague; pubescence golden, short, appressed; prosternum minutely punctate at middle. Elytra more than 2½ times as long as broad, strongly tapering; punctures dense, smaller than those on pronotum; pubescence short, depressed, appearing golden in oblique light; apices narrow, oblique, shallowly emarginate. Legs slender; femora subglabrous internally. Abdomen with sternites minutely punctate at bases and middle; last sternite narrow, shallowly impressed at apical one-half, angles dentate. Length, 10-12 mm.

Female: Form more robust. Antennae extending to about middle of elytra. Abdomen with last sternite medially impressed at apex, angles dentate; last tergite with apex barely notched at middle. Length, 12-13 mm.

Type locality: of *rufiventris,* Chontales, Nicaragua; *pubipennis,* Chacoj, Vera Paz, Guatemala.

The rather coarse punctation of the pronotum and golden appearing pubescence of the elytra will readily distinguish this species. It is known from Mexico (Veracruz) to Nicaragua.

Pseudotypocerus virescens Chemsak and Linsley, **new species**

Male: Moderate sized, strongly tapering posteriorly; integument black, shining, having faint greenish to purplish metallic overtones, especially beneath. Head with front broader across genae than length from bases of genae to base of labrum; frons finely punctate, finely clothed with short, dark, erect pubescence; vertex finely, subconfluently punctate, sparsely pubescent; antennae shorter than elytra, segments from 5th with distinct apical poriferous areas, outer segments with smaller poriferous pits at bases also, segments from apex of 5th clothed with short, appressed pubescence which appears golden in oblique light. Pronotum moderately convex, apex narrowly impressed; disk shining, densely, moderately coarsely punctate, punctures larger than those at base of elytra; pubescence dark, depressed, moderately dense; prosternum very finely, densely punctate except at sides, pubescence dense; meso- and metasternum finely, densely punctate, densely clothed with depressed pubescence which appears golden in oblique light. Elytra about 2.8 times as long as broad, sides narrowing before middle; punctures rather fine, well separated; pubescence short, depressed, dark; apices dehiscent, obliquely truncate. Legs slender; femora golden pubescent in oblique light, tibiae dark pubescent. Abdomen with sternites finely, densely punctate at bases and middle, densely pubescent at same areas; last sternite elongate, narrow, impressed over apical 1/3; last tergite rounded at apex, notched at middle. Length, 14 mm.

Holotype: male (National Museum of Natural History) from Barro Colorado Island, Panama, 20-23 May 1964 (W. D. and S. S. Duckworth).

The broader face and black elytral pubescence will separate this species from *rufiventris.*

Pseudotypocerus inflaticollis Chemsak and Linsley, **new species**

Female: Form moderate sized, robust, strongly tapering posteriorly; integument black, most of head, prothorax and scutellum orange, abdomen with greenish metallic overtones. Head with front square; frons finely, densely punctate, clothed with fine, dark sworling hairs; vertex very finely, confluently punctate, very finely pubescent; antennae extending to about middle of elytra, segments from apex of 5th densely clothed with short appressed, golden-appearing pubescence, poriferous areas very small from 6th segment. Pronotum inflated, apex abruptly constricted, narrowly impressed; punctures shallow, fine, confluent; pubescence brown-orange, depressed, moderately dense; prosternum glabrous except for V between coxae; meso- and metasternum finely, densely, shallowly punctate, moderately densely clothed with short, bronze, depressed pubescence. Elytra about 2 1/2 times as long as broad; punctures rather fine, dense, granulate; pubescence black, short, depressed; apices shallowly, obliquely emarginate. Legs slender; hind tibiae with long spurs. Abdomen very finely, densely punctate, pubescence pale, very short, rather dense; last sternite barely impressed at apex, margin bi-emarginate, angles finely dentate; last tergite emarginate at apex. Length, 11-15 mm.

Holotype: female (National Museum of Natural History) from Arraijan, Panama, October 1947, Trap catch, (J. Zetek). One female paratype with same label data. Two additional female paratypes from La Campana, Panama, July-November, 1938 (J. Zetek) and Fort Clayton, Albrook Forest Site, Canal Zone, 25-26 May 1967, black light trap (Hutton and Llaurado).

This species may be readily recognized by the coloration, inflated pronotum, and by the golden pubescent distal antennal segments.

Pseudotypocerus cantharidis Chemsak and Linsley, **new species**

Female: Form moderate sized, tapering posteriorly; integument yellow, head, antennae, scutellum, margins of sternites, tibiae, tarsi, most of femora, and last abdominal segment black, elytra narrowly black at apices. Head with front square, sparsely pubescent; frons irregularly punctate; vertex very finely, densely punctate with larger punctures interspersed; antennae extending to about middle of elytra, segments from fifth with small poriferous areas, basal segments throughout and distal segments beneath clothed with bronze or golden pubescence. Pronotum moderately convex; apex shallowly impressed; disk finely, subconfluently punctate; pubescence pale, appressed, moderately dense; prosternum glabrous except for V between coxae; meso- and metasternum minutely, densely punctate, densely clothed with golden appressed pubescence. Elytra about 2 1/2 times as long as broad; basal punctures fine, dense, granulate; pubescence short, golden, depressed; apices obliquely emarginate. Legs slender; middle and hind tarsi with pubescence appearing golden in oblique light. Abdomen minutely, densely punctate, densely pubescent; last sternite barely impressed at middle, margin bi-emarginate, angles obtuse; last tergite deeply emarginate at apex, angles dentate. Length, 13-16 mm.

Holotype: female (California Academy of Sciences) from Cerro Campana, Panama Prov., Panama, 850 M., 8° 47′ N, 79° 56′ Wm 22 May 1972 (W. Bivin). Paratypes, all female as follows: 1, Cerro Campana, Panama Prov., Panama, 1 August 1970 (H. and A. Howden); 1, Turrialba, Cartago Prov., Costa Rica, 2-7 June 1967 (J. Robertson); 1, Turrialba, June, July 1949 (K. W. Cooper); 1, Turrialba (E. A. Bottcher); 1, 8 km S Guapiles, Rio Toro Amarillo, Limon Prov., Costa Rica, 18 July 1964 (R. E. Woodruff); 2, San Carlos, Costa Rica (Schild and Burgdorf).

The coloration of this species is relatively uniform in the type series with variation expressed primarily in the extent of the apical dark spots of the elytra; several specimens have the apical 1/3 dark.

This species is suggestive of a cantharid beetle, and H. F. Howden actually collected a specimen at Cerro Campana, Panama in the company of a yellow and black cantharid with a black head and antennae and the black abdomen protruding slightly beyond the elytra giving them a black-tipped appearance.

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OBITUARY & BIBLIOGRAPHY OF J. FRANK BRIMLEY, SR.

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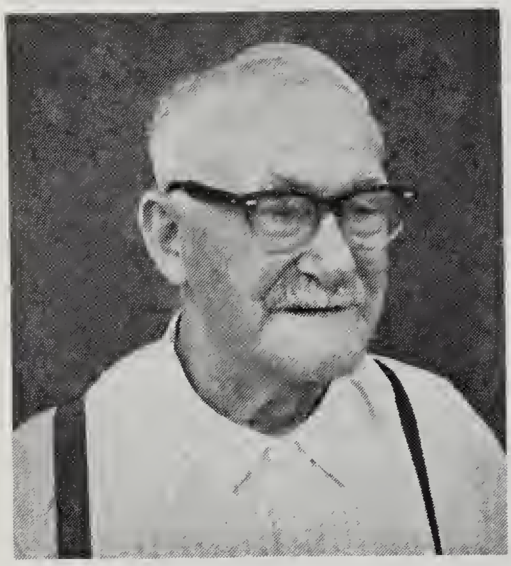
J. Frank Brimley, Sr., one of Canada's "old time" naturalists, died 6 January 1976 in Wellington, Ont., after a brief illness. Born in 1883 in London, England, Mr. Brimley emigrated to Prince Edward County, Ontario in 1909 with his wife and daughter. Except for 1 year in Rainy River and 2 years at Hamilton, Mr. Brimley lived near or in Wellington. In 1928 he purchased a grocery store in Wellington and lived above the store until his death.



Mr. Brimley's interest in nature began in England, where he started collecting insects as a young boy. After emigrating to Ontario, he continued to collect, specializing for the most part in Coleoptera and Hemiptera-Homoptera (excluding the soft-bodied species). He amassed a pinned collection of about 40,000 beetles (about 5,000 species) and 10,000 bugs (about 1,000 species), all from Canada and the United States; much of this material is identified to species. Besides the pinned material he had 25,000 beetles and 18,000 bugs in papers, most of which consisted of named duplicates collected locally. His collection was bequeathed to the Canadian National Collection of Insects, Ottawa.

Mr. Brimley was an avid trader and a look at his collection indicates that he exchanged beetles and bugs with a great many of the entomologists of his time, professional or amateur, in North America. Most of the material he collected bears the familiar "Pr. Edw. Co., Ont." label, although he did spend a month or 2 in Florida during several winters and 1 year in the Rainy River District, Ont. He collected many "first records" for Canada, especially in the Hemiptera-Homoptera. He did not report most of this information, other than by placing the specimens in his collection. At 92, Mr. Brimley was Canada's oldest active entomologist, identifying beetles for others up until 5 months before he died.

Predeceased by his wife (1963), Mr. Brimley is survived by 2 daughters, a son, and several grandchildren and great-grandchildren.

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NEW WORLD LIMNICHINAE I: A REVISION OF THE GENUS *PHYSEMUS* LECONTE (COLEOPTERA: LIMNICHIDAE)

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Abstract

The taxonomic status of the genus *Physemus* is briefly discussed. Illustrations, a distribution map, and a key to separate the species are presented and the new species *P. punctatus* from Colombia, *P. latifrons* from Panama, and *P. excavatus* from Central America are described.

The genus *Physemus* consists of minute, apparently sub-aquatic species. Adults may be taken by throwing water over muddy banks of rivers and streams, or they may be found running actively over drying mud. They are most frequently taken at light. The larvae are unknown but are probably not truly aquatic. *Physemus* is most closely related to the Old World genus *Bothriophorus,* from which it differs by having a 2-segmented rather than 3-segmented antennal club.

Except for the more compact and fewer-segmented antennal clubs and their reception in lateral pronotal excavations in repose, and the somewhat larger than usual clypeus, *Physemus* and *Bothriophorus* closely resemble other members of the subfamily Limnichinae. These differences have been used to establish a separate subfamily, Bothriophorinae (Dalla Torre 1911, in cat.). However, the differences between *Physemus* and other members of the Limnichinae are no greater than differences between other genera in the subfamily. I therefore agree with Casey (1912) that, at best, tribal differences are reflected. I retain the tribe Bothriophorini, as proposed by Casey, for those species of Limnichinae with lateral cavities on the dorsal surface of the pronotum for receiving the antennae in repose.

Acknowledgements

The material used in this study was from the collections listed. I wish to thank the curators for making this material available to me. California Academy of Sciences, San Francisco (CAS), H. B. Leech and D. H. Kavanaugh; Illinois Natural History Survey, Urbana (INHS), M. W. Sanderson; Museum of Comparative Zoology, Cambridge (MCZ), J. F. Lawrence; Texas A&M University, College Station (TAM), H. R. Burke and J. C. Schaffner; and the U. S. National Museum (USNM), P. J. Spangler.

Genus *Physemus* LeConte

Physemus LeConte 1854:117; Casey 1889:160; Casey 1912:57.
Type-species: *Physemus minutus* LeConte, by monotypy.
Ditaphrus Casey 1886:250. Type species: *Ditaphrus scymnoides* Casey, by monotypy.

Size small, 0.85 to 1.2 mm. Broadly ovate, subacute posteriorly, covered with short, decumbent, easily eroded pubescence. Head retractible into prothorax; eyes subvertical, coarsely faceted, surmounted by cariniform ridge; epistoma separated from front by distinct suture; pubescent depression on each side in front of eye behind antennal insertion. Antennae 11-segmented, longer than head, free when head retracted; club 2-segmented, terminal segment large and oval. Pronotum with deep lateral pits on upper surface to receive distal parts of antennae in repose (Fig. 1, a); anterior margin narrowly polished. Elytra at base as wide as pronotum and continuing its outline. Median line of pronotum not impressed. Coxae all widely separated. Thoracic sternites and 1st visible abdominal sternite with deep grooves for reception of femora and tibiae in repose. Abdomen with 5 visible sternites.

The genus consists of 4 known species, all from the Western Hemisphere (Fig. 2).

KEY TO THE SPECIES OF *Physemus*

1. Mesosternal punctation fine along midline, at least some coarser punctures at sides and around mesocoxal cavities; elytral punctation various 2

1′. Mesosternal punctation even, fairly coarse throughout; elytral punctation very coarse, punctures widely separated. Colombia .... *P. punctatus* n. sp.

2(1). Pubescent pits in front of eyes and above antennal insertions deep and well-marked, frons appearing constricted in front of eyes 3

2′. Pubescent pits in front of eyes and above antennal insertions shallow and barely depressed, frons appearing broad in front of eyes. Canal Zone .... *P. latifrons* n. sp.

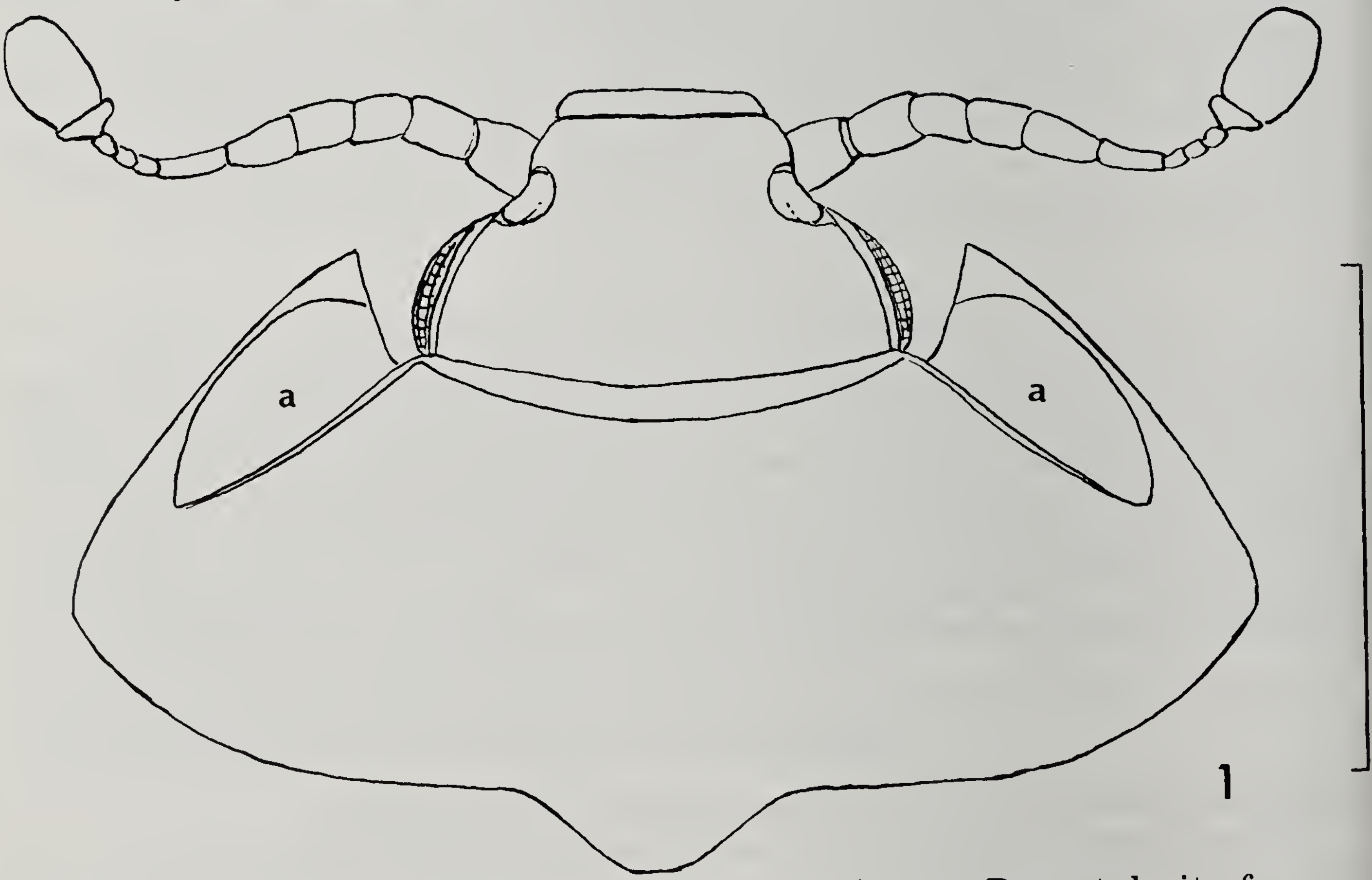

Fig. 1. Head and pronotum of *Physemus minutus*. Pronotal pits for reception of antennae are designated by “a”. (Line = 0.20 mm).

3(2′). Second visible abdominal sternite with an irregular row of coarse punctures extending across center of sternite from side to side. Southwest United States and northern Mexico....... .... *P. minutus* LeConte

3′. Second visible abdominal sternite with numerous, irregularly scattered coarse punctures that become thicker at sides of sternite. El Salvador, Guatemala, and Honduras .... *P. excavatus* n. sp.

Physemus minutus LeConte 1854:117; Casey 1889:160-1; Casey 1912:58. Type locality: Colorado River, California. Type series located in MCZ, no holotype designated.

Ditaphrus scymnoides Casey 1886:250. Type locality: Texas. Type located in USNM.

Description: Male: Length 1.0 mm. Width 0.6 mm. Oval, acutely ogival posteriorly, convex. Head black; punctation coarse and close; pits on sides of head deep and well-marked; frons narrow between pits. Pronotum black; punctation fine on disk, coarser toward sides; narrowly glabrous at anterior margin. Elytra black, punctures coarse, fairly close (separated by 2 to 3 times diameter of each), becoming interspersed with finer punctures toward apex. Ventral surface dark red-brown. Maxillary and labial palpi dark red-brown. Antennae red-brown. Legs dark red-brown. Metasternal punctation fine along mid-line, becoming progressively coarser toward sides. Metacoxae coarsely punctate. Abdomen finely punctate, row of coarse punctures extending nearly from one lateral margin to other on 2nd to 4th visible sternites. Parameres of aedeagus long, flat, and slender, expanding inward just before the rounded tips. Penis narrowing from base to about midpoint, then narrowly parallel-sided to acute tip (Fig. 3).

Female: Externally identical to male, except lacking fine secondary punctation at apex of elytra. Genitalia as in Fig. 4.

Distribution: This species occurs from Texas to Southern California, into northern Mexico (Fig. 2).

Material Examined: (174 specimens): ARIZONA: no other data, [MCZ, USNM] (12); Ft. Yuma, 21-I to 8-IV, Hubbard and Schwarz [USNM] (22); Superior, 17-VII to 5-VIII-49, H. K. Gloyd, at light [INHS] (24); Superior, Boyce Thompson SW. Arboretum, 31-VII to 17-IX-49, B. W. Benson, at light [INHS] (8); Tucson, 21-IV to 21-IX, Hubbard and Schwarz [USNM] (4); Yuma, VIII, A. Fenyes Coll. [CAS] (1). CALIFORNIA: no other data [CAS, MCZ] (5) S. Dimas, 28-VII-91, Fall [CAS] (1); Los Angeles, Coquillett [USNM] (1); Pomona, 18-I-92, F. Blanchard Coll. [MCZ] (1); Yuma, 5 to 7-VII-33, Wickham [CAS, MCZ, USNM] (29) Yuma, 6-VIII, Liebeck Coll. [MCZ] (5); San Diego Co., 22-XI-90, F. E. Blaisdell [CAS] (1). TEXAS: Brownsville, Esper Rch, 1929 [USNM] (1), VI-29 [USNM] (1); Brownsville, VII-33, Wickham [USNM] (1); Brownsville, 30-IV to 3-V-04, H. S. Barber [USNM] (11); Eagle Pass, 30-III-08, Jones and Pratt [USNM] (1); El Paso, 1933, Wickham [USNM] (1); Gonzales Co., Palmetto St. Pk., 7-VI-69, Board and Hafernik [TAM] (28); San Antonio, 1933, Wickham [USNM] (1); San Patricio Co., Wilder Wildlife Refuge, 28-VI-69, Board and Hafernik [TAM] (13). MEXICO: *Sinaloa*: [USNM] (1).

In addition I have seen one specimen labelled Cape Sable, Florida, 5-IV-26, ex. stomach of *Passerherbulus mirabilis*. The locality must remain doubtful until other specimens are found in nature.

Physemus punctatus Wooldridge, **new species**

Holotype: Male. Pto. Colombia, Darlington. MCZ Type #32244. Length 1.1 mm. Width 0.75 mm. Broadly oval, convex. Head black; punctation fine and close; pubescent pits on sides behind antennal insertions deep and large, but frons not appearing constricted. Pronotum black; punctation sparse, somewhat finer than on elytra; pubescence sparse, yellow. Elytra black; punctures very coarse, widely separated (by 3 to 5 times diameter of each), some finer punctures toward apex; pubescence sparse, yellow. Ventral surface dark red-brown. Maxillary and labial palpi yellow-brown. Antennae yellow-brown, club darker. Legs red-brown. Metasternum evenly, fairly coarsely punctate, punctures not noticeably finer along midline. Mesocoxae evenly punctate, punctures about as on metasternum. Abdomen evenly, moderately finely punctate. Parameres of aedeagus wide, outer margins curving inward, inner margins straight, in repose held against the slender penis to give a solid, rounded tip (Fig. 5).

Allotype: Female. Same data as holotype. Externally identical to male, except lacking finer punctures toward apex of elytra. Genitalia as in Fig. 6.

Paratypes: 1 male, 1 female. Same data as holotype.

Distribution: Known only from type locality (Fig. 2) (Puerto Colombia, Atlántico, Colombia).

Physemus latifrons Wooldridge, **new species**

Holotype: Female. Panama, Canal Zone. Ancon, 12-V-11, arc light, A. H. Jennings. USNM Type #73399. Length 0.88 mm. Width 0.62 mm. Broadly oval, convex. Head black; punctation fine, even; pubescent pits on sides above antennal insertions shallow and rounded, frons broad between pits; covered with short, decumbent golden hairs. Pronotum dark red-brown; punctation fine, even; pubescence of short golden hairs; narrowly glabrous and polished around antennal pits. Elytra dark red-brown, paler toward

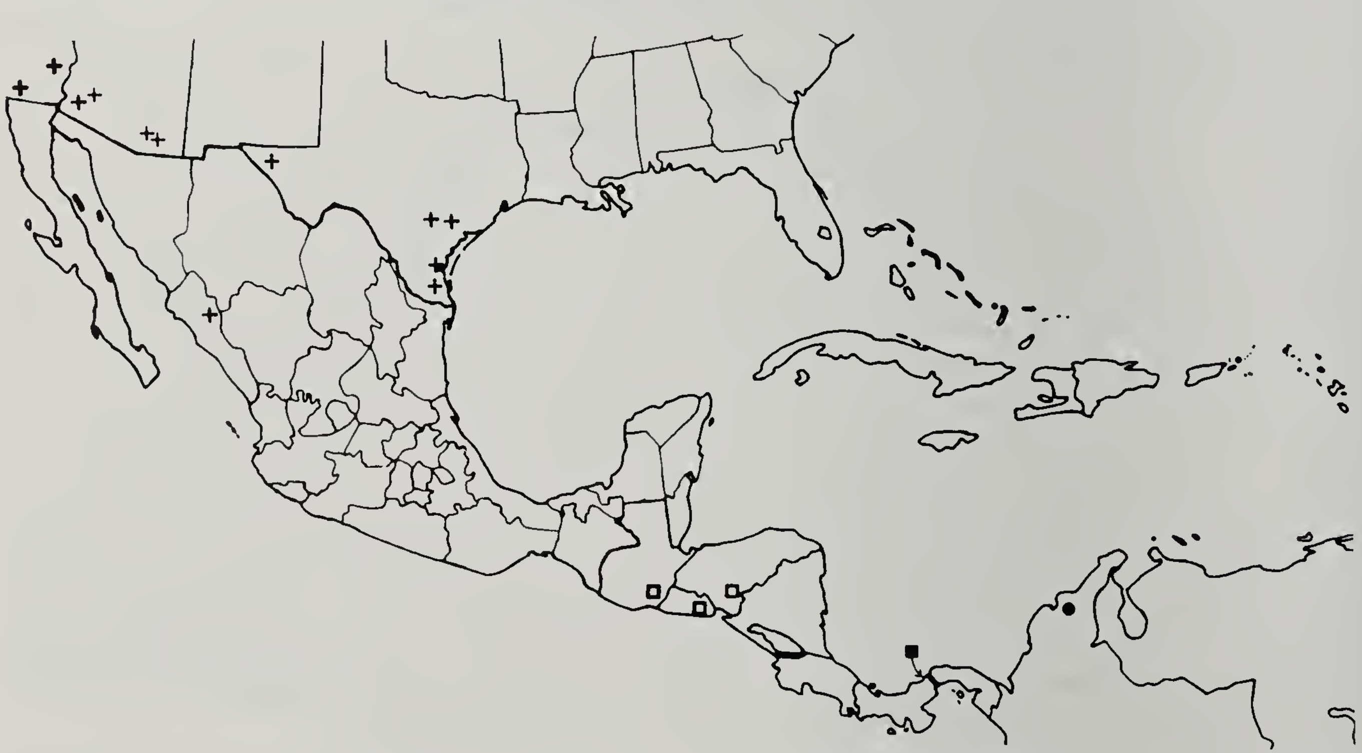

Fig. 2. Distributions of *Physemus* spp. Plus = *Physemus minutus*; open square = *P. excavatus*; solid square = *P. latifrons*; solid circle = *P. punctatus*.

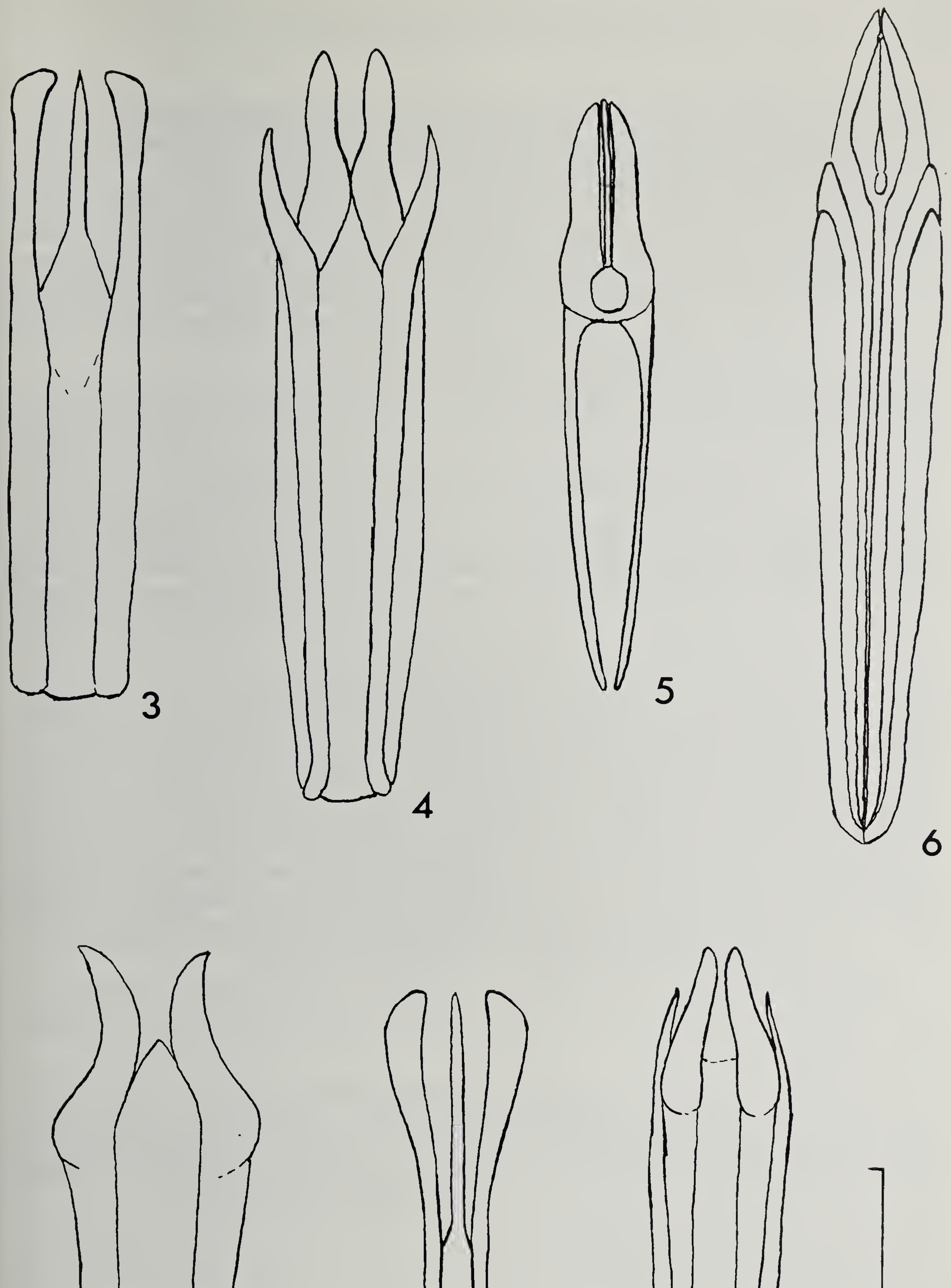

Fig. 3-9. Genitalia of *Physemus* spp: 3) male, *P. minutus*; 4) female, *P. minutus*; 5) male, *P. punctatus*; 6) female, *P. punctatus*; 7) female, *P. latifrons*; 8) male, *P. excavatus*; 9) female, *P. excavatus*. (Line = 0.20 mm).

apex; punctures fine, even, close (separated by 1 to 2 times diameter of each), somewhat coarser toward apex; pubescence of short decumbent golden hairs. Ventral surface light red-brown; abdominal sternites paler at sides, last segment darker in middle. Maxillary and labial palpi yellow. Antennae yellow, club red-brown. Legs yellow, except hind legs light red-brown. Metasternum very finely punctate, few slightly coarser punctures at sides and around mesocoxal cavities. Metacoxae very finely punctate. Abdomen evenly, finely punctate. Genitalia with coxites broad and strongly curved, convex sides directed inward (Fig. 7).

Paratype: 1 female. Same data as holotype.

Distribution: Known only from type locality (Fig. 2).

Physemus excavatus Wooldridge, **new species**

Holotype: Male. Honduras, 12 k. W. Olanchito, VI-22-1949, E. C. Becker. INHS. Length 1.0 mm. Width 0.75 mm. Broadly oval, convex. Head black; punctation fine, close; pits above antennal insertions very deep and broad; sides of frons forming shelf over antennal insertions; narrow between pits. Pronotum black; punctation fine on disk, coarser at sides, very close. Elytra black; punctures coarse, close (separated by 2 to 3 times diameter of each), coarser toward apex, but with some finer punctures interspersed. Ventral surface red-brown, abdomen dark red-brown along sutures. Maxillary and labial palpi red-brown. Antennae yellow, club red-brown. Legs red-brown. Metasternal punctation fine in center, very coarse at sides and near mesosternum. Metacoxae with series of deep coarse punctures. Abdomen opaque, coarsely, irregularly punctate. Parameres of aedeagus long and slender, widening slightly before the rounded tips. Penis narrowing abruptly at about half its length, then parallel-sided to the acute tip. Entire aedeagus strongly curved upward (Fig. 8).

Allotype: Female. Same data as holotype. Externally identical to male, except lacking secondary fine punctures near apex of elytra. Genitalia as in Fig. 9.

Paratypes: 2 males, 6 females. EL SALVADOR: 1 male, 1 female, Lk. Ilopango, VIII-2-1965, P. J. Spangler (USNM). GUATEMALA: 1 male, 2 females, Suchil, Fca. Lamaquina (22 km South) Rio Sis, 11 June 1966, O. S. Flint Jr. (USNM). HONDURAS: 2 females, same data as holotype. 1 female, same data as holotype, except Sept. 7, 1949 (INHS). (See Fig. 2).

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LECTOTYPE DESIGNATIONS FOR VARIOUS SPECIES OF NORTH AMERICAN *PITYOPHTHORUS* EICHHOFF (COLEOPTERA: SCOLYTIDAE)

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Abstract

Lectotypes are designated for the following species of North American *Pityophthorus*: *annectans* LeConte, *atratulus* (LeConte), *bassetti* Blackman, *blandulus* Schedl, *cacuminatus* Blandford, *confinis* LeConte, *confusus* Blandford, *consimilis* LeConte, *deletus* LeConte, *digestus* (LeConte), *diglyphus* Blandford, *glabratulus* (Schedl) (new combination), *guatemalensis* Blandford, *hirticeps* LeConte, *liquidambaris* Blackman, *natalis* Blackman, *nigricans* Blandford, *nitidulus* (Mannerheim), *nocturnus* Schedl, *obtusipennis* Blandford, *occidentalis* Blackman, *pellitus* Schedl, *politus* (Blandford) (now in *Araptus*), *pulicarius* (Zimmermann), *pullus* (Zimmermann), *puncticollis* (LeConte), *scabridus* Schedl, *schwerdtfegeri* (Schedl), *scriptor* Blackman, and *subsimilis* Schedl.

Many species of *Pityophthorus* described by the early authors do not have definite type specimens designated for them. Since I am presently preparing a monograph of this genus in North and Central America, it is desirable that type designations be made in order to definitely establish each name. The original purpose of the present study was to designate a type for each species of North American *Pityophthorus* that does not have a definite holotype. However, the types of the 7 species of *Pityophthorus* described by Eichhoff were apparently destroyed in the destruction of Hamburg, Germany during World War II. Specimens that could serve as neotypes have been located for 4 of Eichhoff's species, but since neotypic specimens of 3 species are still unlocated, I have left a discussion of the Eichhoff types out of this paper.

The species are listed in alphabetical order under each author's name.

Species described by M. W. Blackman

M. W. Blackman described about 80 species of *Pityophthorus*, all but 5 of which have proper holotype designations. All lectotypes are in the United States National Museum of Natural History, Washington, D. C.

P. bassetti: 1920, p. 1. Described from an unrecorded number of specimens. Lectotype (male), here designated, is labelled: Pitkin, Colo./M. W. Blackman, collector/706/TYPE/Type No. 56924 U.S.N.M./LECTOTYPE Pityophthorus bassetti Blackman, D. E. Bright, 1976.

P. liquidambaris: 1921, p. 4. "Described from a long series of specimens". Lectotype (female), here designated, is labelled: Mound, Louisiana, 3-2-20/M. W. Blackman, collector/N.Y.S. Coll. For. Lot. No. Mi 149/TYPE/Type No. 56913 U.S.N.M./LECTOTYPE Pityophthorus liquidambaris Blackman, D. E. Bright, 1976.

P. natalis: 1921, p. 8. Described from a series of 27 specimens. Lectotype (male ?), here designated, is labelled: Mississippi A&M, 11-7-1919/M. W. Blackman, collector/N.Y.S. Coll. For. Lot. No. Mi 22/TYPE/Type No. 56911 U.S.N.M./LECTOTYPE Pityophthorus natalis Blackman, D. E. Bright, 1976.

P. occidentalis: 1920, p. 4. Described from an unrecorded number of specimens. Lectotype (male), here designated is labelled: Pitkin, Colo., 14-5-15/Bassett, coll./N.Y.S. Coll. For. Lot No. 698/o TYPE/Type No. 56920 U.S.N.M./LECTOTYPE Pityophthorus occidentalis Blackman, D. E. Bright, 1976.

P. scriptor: 1921, p. 7. Described from a series of 70 specimens. Lectotype (female), here designated, is labelled: Mississippi A&M, 2-14-1920/M. W. Blackman, collector/N.Y.S. Coll. For. Lot No. Mi 132/Type Pityophthorus scriptor Blackman/Type No. 41763 U.S.N.M./LECTOTYPE Pityophthorus scriptor Blackman, D. E. Bright, 1976.

Species described by W. F. H. Blandford

In the Biologia Centrali-Americana, Blandford described 17 species in *Pityophthorus*. One species, *P. deyrollei,* was transferred to *Thamnophthorus* by Schedl (1938) and subsequently to *Araptus* by Wood (1974), who designated a lectotype at the same time. Eight of Blandford's species were described from 1 specimen each and therefore have holotypes. Wood transferred *P. politus* (1973) and *P. confinis* (1975) to *Araptus,* and a lectotype for *P. politus* is designated herein. This and the remaining *Pityophthorus* species are listed below. All type material is in the British Museum (Natural History), London.

P. cacuminatus: 1904, p. 238. Three specimens are in the type series. Lectotype (female), here designated, is labelled: Type (orange bordered circle)/S. Geronimo, Guatemala, Champion/B.C.A. Col. IV-6, Pityophthorus cacuminatus Blandf./LECTOTYPE Pityophthorus cacuminatus Blandford, D. E. Bright, 1976.

P. confusus: 1904, p. 237. Described from 3 specimens. Lectotype (female), here designated, is labelled: Type (orange bordered circle)/S. Geronimo, Guatemala, Champion/B.C.A. Col. IV-6, Pityophthorus confusus Blandf./LECTOTYPE Pityophthorus confusus Blandford, D. E. Bright, 1976. One syntypic specimen with identical data is labelled as a paralectotype.

P. diglyphus: 1904, p. 240. Four specimens are in the type series. Lectotype (male), here designated, is labelled: Co-Type (yellow bordered circle)/Quiche Mts., 7-9000 ft., Champion/B.C.A. Col. IV-6, Pityophthorus diglyphus Blandf./Pityophthorus diglyphus Bld. (In Blandford's (?) handwriting, label upside down/LECTOTYPE Pityophthorus diglyphus Blandford, D. E. Bright, 1976. The other 3 specimens, all from Balhen, Vera Paz, are labelled paralectotypes.

P. guatemalensis: 1904, p. 239. Described from a series of 20 specimens. Lectotype (female), here designated, is labelled: Co-Type (yellow bordered circle)/Guatemala City, Champion/F. W. Sampson coll., BM 1926-482 (label upside down)/B.C.A. Col. IV-6, Pityophthorus guatemalensis Blandf./Pityophthorus guatemalensis Bld. (in Blandford's (?) handwriting, label upside down)/LECTOTYPE Pityophthorus guatemalensis Blandford, D. E. Bright, 1976. Thirteen additional specimens are labelled as paralectotypes.

P. nigricans: 1904, p. 236. Described from 3 specimens. Lectotype (female), here designated, is labelled: Quiche Mts., 7-9000 ft., Champion/B.C.A. Col. IV-6, Pityophthorus nigricans Blandf./Pityophthorus nigricans Blandf (in Blandford's handwriting, label upside down)/LECTOTYPE Pityophthorus nigricans Blandford, D. E. Bright, 1976. Two other specimens bear the same data are designated as paralectotypes.

P. obtusipennis: 1904, p. 240. The type series consists of 2 specimens. Lectotype (male), here designated, is labelled: Type (orange bordered circle)/Balheu, Vera Paz, Champion/B.C.A. Col. IV-6, Pityophthorus obtusipennis Blandf./LECTOTYPE Pityophthorus obtusipennis Blandford, D. E. Bright, 1976.

P. politus: 1904, p. 244. Described from 2 specimens. Letotype (sex undetermined) here designated, is labelled: Syn-Type (blue bordered circle)/small green rectangle with MPX/Ex coll. A. Deyrolle/Mexico/F. W. Sampson coll. BM 1926-482 (label upside down)/P. politus/Neodryocoetes (Pityophthorus) politus Blandf. Det K. E. Schedl/LECTOTYPE Pityophthorus politus Blandford, D. E. Bright, 1976. The other specimen is labelled as a paralectotype.

This species was transferred to *Araptus* by Wood (1973).

Species described by J. L. LeConte

LeConte described 12 species, the names of which are now either valid or synonyms in *Pityophthorus* as the genus is now recognized. Numerous other species were described or placed in *Pityophthorus* by LeConte but have now been transferred to other genera. No holotypes were designated in LeConte's original descriptions. The entire collection was examined and the type specimens labelled as either holotypes or lectotypes. Eight species that require the formal designation of lectotypes are listed below. All type material is in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

P. annectans: 1878a, p. 622. Described from an unrecorded number of specimens. Three specimens are under this name in the collection. The lectotype (female), here designated, is the first specimen and is labelled: Tampa, Fla. 1-4/1492/Type 1283/P. annectans Lec/LECTOTYPE Pityophthorus annectans LeConte, D. E. Bright, 1976. The other two specimens are labelled as paralectotypes.

P. atratulus: 1868, p. 156. Described from 2 specimens and placed in *Cryphalus*. The lectotype (sex undetermined), here designated, is labelled: a gold disk/Type 1000/C. atratulus Lec/nitidulus 4/LECTOTYPE Cryphalus atratulus LeConte, D. E. Bright, 1976. The second specimen is labelled as a paralectotype.

This species is a synonym of *P. nitidulus* (Mann.).

P. confinis: 1876, p. 354. Described from a series of 2 specimens. The lectotype (female), here designated, is labelled: Cala./Type 1030/P. confinis Lec./LECTOTYPE Pityophthorus confinis LeConte, D. E. Bright, 1976. The second specimen is labelled as a paralectotype.

P. consimilis: 1878a, p. 622. LeConte did not record the number of specimens in the original series, however 3 specimens are presently in the collection. The first specimen is hereby designated the lectotype (male), and is labelled: Marquette, Mich., 1-7/[female sign] (error)/Type 1284/P. consimilis Lec./LECTOTYPE Pityophthorus consimilis LeConte, D. E. Bright, 1976. The 2 remaining specimens are designated as paralectotypes.

P. deletus: 1878b, p. 519. Described from a series of 5 specimens, of which 3 specimens and an empty pin remain in the collection. The first specimen is hereby designated the lectotype and is labelled: Veta Pass, Colo., 21-6/Type 1286/668/P. deletus Lec/LECTOTYPE Pityophthorus deletus LeConte, D. E. Bright, 1976. The remaining specimens are designated as paralectotypes.

P. digestus: 1874, p. 71. Originally described in *Cryphalus*. Ten specimens are in the collection, 8 of these are mounted on one pin, on 4 cards, 2 specimens per card. The lectotype, here designated, is the left specimen on the top card on the first pin. There is a small black dot just behind the elytral apex of the lectotype which serves to definitely indicate which specimen is the type. The pin bears the labels: Type 997/C. digestus Lec/LECTOTYPE-Top left specimen—Cryphalus digestus LeConte, Bright, 1976. A paralectotype label has been placed on the pin for the remaining 7 specimens. Two additional specimens are also labelled as paralectotypes.

P. hirticeps: 1878a, p. 665. The size of the type series was not given by LeConte, however, 2 specimens are presently in the collection. The first specimen (male), hereby designated the lectotype, is labelled: Marquette, Mich. 3-1/female (error)/Type 1285/P. hirticeps Lec./LECTOTYPE Pityophthorus hirticeps LeConte, D. E. Bright, 1976. The remaining specimen is designated as a paralectotype. LeConte erred in designating the sex of the specimen labelled as lectotype.

This species is a synonymn of *P. pulchellus* Eichhoff.

P. puncticollis: 1874, p. 71. LeConte described this species in *Cryphalus* from 1 specimen from California and at least 1 specimen from Texas. There are 4 specimens in the collection now, none of which is from Texas, 1 is from California and the other 3 are from Colorado. These latter 3 have obviously been added subsequent to LeConte's description. The whereabouts of the Texas specimen(s) is unknown.

The first specimen (female) is hereby designated the lectotype and is labelled: Cala./Type 999/C. puncticollis Lec./LECTOTYPE Cryphalus puncticollis Le-

Conte, D. E. Bright, 1976. The other 3 specimens are not given any type designations and bear only my identification label in addition to the original labels.

This species is a synonymn of *P. nitidulus* (Mann.).

Species described by C. G. Mannerheim

Only one species of North American *Pityophthorus* was described by Mannerheim. The type material is in the Zoological Museum, Helsinki, Finland.

P. nitidulus: 1843, p. 298. Described in *Bostrichus* from an unrecorded number of specimens. Three specimens are in the Mannerheim collection. The first of these, hereby designated the lectotype, is labelled: Blaschke/Sitka/coll. Mannerh./Bostrichus nitidulus Mannerh. n. sp., Blaschke-Sitka/Mus. Hifors. Spec. typ. No. 1186, Bostrichus nitidulus Mann./LECTOTYPE Bostrichus nitidulus Mannerheim, D. E. Bright, 1974. The other 2 specimens were collected by Frankhauser and may not be part of the original type series. Mannerheim gave a range of measurements, indicating he had more than 1 specimen and stated that Blaschke was the collector; Frankhauser is not mentioned. Only 1 specimen (the lectotype) bears a Blaschke label. It is obviously the specimen that Mannerheim considered the type. The other 2 specimens could have been added at a later date or Mannerheim could have given only the collector of the specimen he considered the type.

Species described by K. E. Schedl

Schedl has described about 14 species, the names of which are either valid or synonyms of North American *Pityophthorus*. Several additional species were described in *Pityophthorus* but have now been transferred to other genera. Only 7 species need to have lectotypes designated for them and they are listed below. Lectotypes are in the Schedl collection, Lienz, Austria (eventually to be deposited in the Vienna Museum) except for the type *P. nocturnus,* which is in the British Museum (Natural History).

P. blandulus: 1956, p. 19. Described from an unrecorded number of specimens. Three specimens labelled as type and paratypes have been seen. The lectotype (female), here designated, is labelled: Las Trojadas (2), Pin. rud.; 20-9-1951, Guatemala, leg. F. Schwerdtfeger/[female sign]/75/Type Pityophthorus blandulus Schedl/LECTOTYPE Pityophthorus blandulus Schedl, D. E. Bright, 1976. The 2 other specimens bear the same data and are paralectotypes but are not so labelled.

P. glabratulus: 1956, p. 26. Described in *Ctenyophthorus* but here transferred to *Pityophthorus* (**new combination**). Six specimens from the type series have been examined. The lectotype (female), here designated, is labelled: 58, Quezaltenango, Pin. rud.; 6-9-1951, 2750m, Guatemala, leg. F. Schwerdtfeger/[female sign]/Type Ctenyophthorus glabratulus Schedl/LECTOTYPE Ctenyophthorus glabratulus Schedl, D. E. Bright, 1976. The remaining specimens are labelled as paralectotypes; 2 are in Schwerdtfeger's collection and 3 are in Schedl's collection.

P. nocturnus: 1938, p. 185. The British Museum and the Schedl collection both contain 2 specimens from the type series. Since the specimens were collected by Champion and originally belonged to the BM(NH), I hereby designate the first specimen in the BM(NH) as the lectotype. This specimen is labelled as follows: Type (a red bordered circle)/San Geronoma, Vera Paz, Champion/Godman-Salvin coll./Pityophthorus nocturnis [male sign], n.sp., Det. K. E. Schedl/LECTOTYPE Pityophthorus nocturnus Schedl, D. E. Bright, 1975. The remaining specimens are labelled as paralectotypes.

P. pellitus: 1956, p. 23. The Schedl collection contains 2 specimens labeled "Type" and the Schwerdtfeger collection contains 3 specimens, 1 of which is labelled "cotype". I hereby designate the female in the Schedl collection as the lectotype. It is labelled: Quezaltenango, Pin. rud., 6-9-1951, 2350 m., Guatemala, leg. F. Schwerdtfeger/[female sign]/57/Type Pityophthorus pellitus Schedl/LECTOTYPE Pityophthorus pellitus Schedl, D. E. Bright, 1976. The other specimens in the Schedl and Schwerdtfeger collections are designated as paralectotypes.

P. scabridus: 1956, p. 24. The Schedl collection contains 4 specimens labelled "Type" (2) and "paratype" (2) and the Schwerdtfeger collection contains 3 specimens, 1 of which is labelled "cotype". I hereby designate the female in the Schedl collection as the lectotype. It is labelled: Quezaltenango, Pin. rud.; 6-9-195_, 2350m, Guatemala, leg. F. Schwerdtfeger/[female sign]/Type Pityophthorus scabridus Schedl/LECTOTYPE Pityophthorus scabridus Schedl, D. E. Bright, 1976. The remaining specimens have been labelled as paralectotypes.

P. schwerdtfegeri: 1956, p. 28. Originally described in *Conophthorus*. Two specimens from the Schedl collection labelled "Type" were seen. The first of these is hereby designated the lectotype. It bears the following labels: Rancho Alegre, Guatemala, 23-IX-195_, F. Schwerdtfeger/Type Conophthorus schwerdtfegeri Schedl/[male sign]/LECTOTYPE Conophthorus schwerdtfegeri Schedl, D. E. Bright, 1975. The other specimen, a female, bears my paralectotype label.

P. subsimilis: 1956, p. 25. Two specimens from the Schedl collection, both labelled "Type", and 4 specimens from the Schwerdtfeger collection, 1 labelled as a cotype, were seen. I hereby designate the female in the Schedl collection as lectotype. It is labelled: Guatem. ciudad, Guatemala, Pin. tenuif., 25-8-1951, leg F. Schwerdtfeger/[female sign]/43/TYPE Pityophthorus subsimilis Schedl/LECTOTYPE Pityophthorus subsimilis Schedl, D. E. Bright, 1976. The remaining 5 specimens are labelled as paralectotypes.

Species described by C. Zimmermann

Two species now placed in *Pityophthorus* were described by Zimmermann. Both were described in *Crypturgus*. All type material is in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

P. pulicarius: 1868, p. 144. No type locality is given in the original description of this species and it is not known how many specimens of this species were before Zimmermann at the time of its description. Four specimens have been seen that could have formed part or all of the type series. The lectotype, hereby designated, is a specimen from the LeConte collection and is labelled: small green square/Type 1001/C. pulicarius Zimm./LECTOTYPE Crypturgus pulicarius Zimmermann, D. E. Bright, 1976. The remaining 3 specimens are left with only the original labels.

The "Type 1001" label on the lectotype was probably put on at some later time and could be disregarded. However, this specimen is the one that other authors have used as the basis of the species, and it is best that the current concept of this species be maintained.

P. pullus: 1868, p. 143. The number of specimens in the type series was not recorded by Zimmermann. I am not absolutely certain that the specimen designated below as the lectotype actually is the original specimen or was part of the original series. No specimens of *P. pullus* from South Carolina (the type locality) are in the LeConte collection and the general collection of the MCZ contains only this 1 specimen from South Carolina. This one specimen could have been part of Zimmermann's collection that came to the MCZ via Crotch, not given directly to LeConte as were many of Zimmermann's other specimens. The evidence strongly suggests that this specimen is actually from Zimmermann since similarly labelled specimens of Zimmermann's other species are in the general collection. In order to stabilize nomenclature, this specimen is hereby designated lectotype. It is labelled: S.C./Cryphalus pullus Zimm./yellow square of paper/LECTOTYPE Crypturgus pullus Zimmermann, D. E. Bright, 1976.

ACKNOWLEDGEMENTS

I wish to express my appreciation to the following individuals for sending the specimens necessary for this study: Dr. D. M. Anderson, Systematic Ent. Lab., USDA, U. S. National Museum of Natural History, Washington, D. C. (USNM); Dr. John F. Lawrence, Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ); Dr. K. E. Schedl, Lienz, Austria; Dr. F. Schwerdtfeger, Gottingen, Germany; Mr. H. Silfverberg, Zoological Museum, Helsinki, Finland; and Dr. R. T. Thompson, British Museum (Natural History), London, England (BMNH). Dr. S. L. Wood, Brigham Young University, Provo, Utah offered several valuable comments and opinions.

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A NEW SPECIES OF *STENELMIS* FROM NORTH CAROLINA (COLEOPTERA: ELMIDAE)

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Abstract

Stenelmis gammoni n. sp. is described from the New River System of North Carolina. It is a very small species (2.29-2.43 mm long) as compared with other *Stenelmis* and most closely resembles *S. humerosa,* from which it differs in being smaller, with distinctly bimaculate elytra and dark palpi.

Introduction

The North American species of the genus *Stenelmis* were revised in a monograph by Sanderson in 1938. In that study he described 18 new species, 17 of which are still valid; however, very few additions have since been made. This paper records *Stenelmis gammoni,* a new species taken from North Carolina. The beetles were collected during a study of the New River by Dr. E. F. Benfield of the Virginia Polytechnic Institute. All were from the South Fork of the New River, Ashe County, North Carolina. Ashe County, in the northwestern-most part of North Carolina, borders on the Stone Mountains of the Appalachian Range. Relationships of the species to water quality, substrate, stream size, and stream order will be published at a later date by Dr. Benfield.

We are pleased to name this species in honor of Dr. James R. Gammon, ecologist and naturalist at DePauw University whose great interest and enthusiasm in aquatic biology has influenced many students including the first author.

The description of *S. gammoni* follows the format of Sanderson (1938). Measurements are based on 25 males and 25 females, although more than 1100 adults were examined. *S. gammoni* is of the *humerosa-sinuata* group, which Sanderson (1938) distinguishes by the long and suddenly dilated last tarsal segment. The diminutive size (2.29-2.43 mm) places it among the smallest *Stenelmis* described. It is most similar to *S. humerosa* but differs in its bimaculate elytra, dark brown to black antennae and palpi, and shape and size of the male genitalia.

Stenelmis gammoni White and Brown, **new species**
Fig. 1 and 2

Size. Male: length, 2.29-2.34 mm; width, 0.90-0.97 mm. Female: length, 2.31-2.43 mm; width 0.90-0.97 mm.

Form and Color. Male and female similar, female slightly longer. Body convex, elongate, slightly wider behind. Elytra dark brown to black. Each elytron bimaculate with humeral spot distinctly embracing umbone (Fig. 1).

Head. Granulations between eye and band irregularly spaced, usually separated by more than twice their diameters. Antennae brown to black, slightly longer than pronotum. Palpi dark brown to black.

Pronotum. Male: length, 0.68-0.73 mm; width, 0.66-0.71 mm. Female: length, 0.68-0.73 mm, width, 0.64-0.73 mm. Pronotum narrowest in front, subparallel from apical angles to anterior third, arcuate in middle, converging slightly before basal angles. Median sulcus moderately deep, extending from anterior margin nearly to base, sides parallel converging broadly in posterior fifth. Lateral impressions sinuate and broader near posterior margin. Tubercles raised and distinct, basal tubercle obliquely elongate, anterior tubercle rounded. Area of median sulcus and lateral impressions dark brown to shining black. Margins of sulcus and tubercles dull yellowish-brown. Granules uniformly distributed over pronotum, irregularly spaced, usually separated by more than twice their width, less conspicuous on lateral margins.

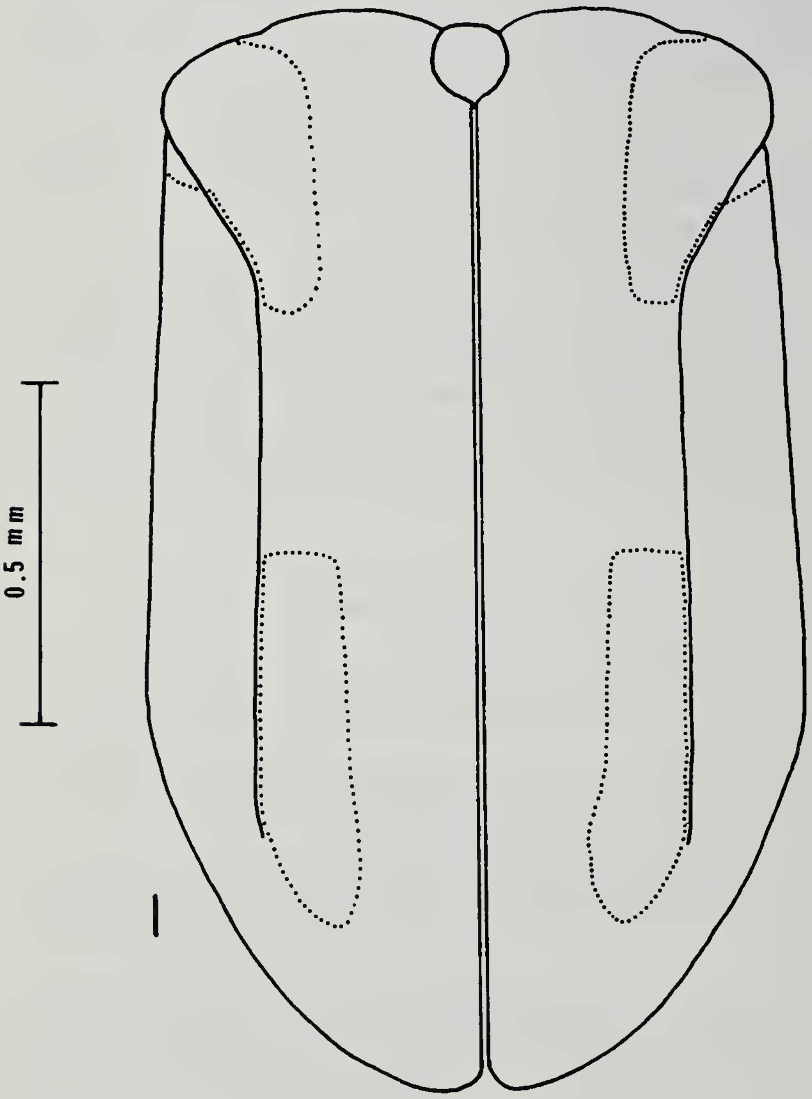
Scutellum. (seen in Fig. 1) Rounded anteriorly, tapering slightly to a point at the elytral suture. Color dull yellowish-brown, similar to the tubercles and sulcus margins of the pronotum.

Elytra. (Fig. 1) Male: length, 1.53-1.65 mm; width, 0.90-0.97 mm. Female: length, 1.60-1.68 mm; width, 0.90-0.97 mm. Elytra bimaculate. Humeral spot wide and rounded, covering umbone to nearly the third interval, well separated from subapical spot. Subapical spot elongate, extending from middle of elytron along and beyond end of sublateral carina of sixth interval. First stria complete. Disk punctures moderately deep and always present though somewhat finer on apical declivity. Third interval noticeably elevated at base.

Venter. Color gray with a bluish to greenish cast on cleaned specimens. Apical abdominal emargination approximately equal to width of last tarsal segment.

Legs. Male: hind tibiae, 0.68-0.73 mm; middle tibiae, 0.59-0.64 mm; front tibiae, 0.54-0.61 mm. Female: hind tibiae, 0.61-0.71 mm; middle tibiae, 0.57-0.64 mm; front tibiae, 0.57-0.61 mm. Last tarsal segment noticeably dilated beyond middle, distinctly longer than other 4 combined. Granules of femora usually separated by less than half their diameters. Tibiae and femora gray, tarsi dark brown to black, claws testaceous to dark brown.

Male genitalia. (Fig. 2) Total length, 0.62-0.64 mm, width, 0.14-0.15 mm, length of median lobe of aedeagus (penis), 0.40-0.41 mm. Penis slightly longer than parameres. Lateral processes on penis prominent but not greatly expanded.



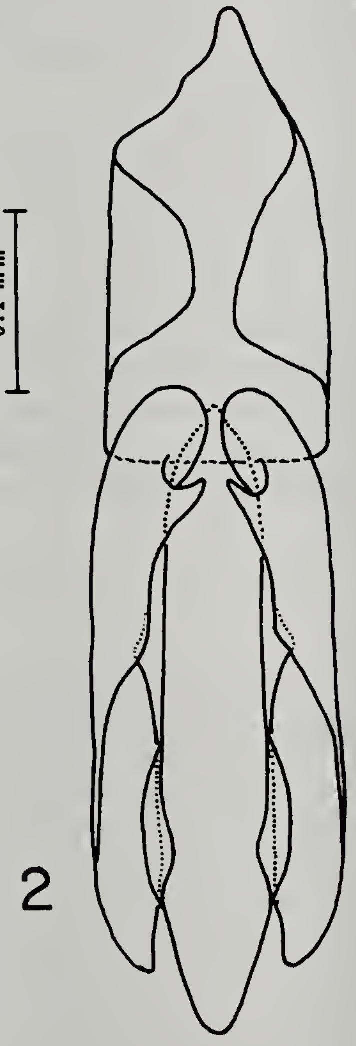


Fig. 1. *Stenelmis gammoni* n. sp., outline of elytra showing position of humeral and subapical spots.

Fig. 2. Outline of male genitalia.

Holotype. Male, United States National Museum of Natural History, Washington. UNITED STATES: North Carolina, Ashe County, South Fork of New River, 3.7 km southeast of Jefferson; elevation 810 m above M.S.L.; 8-V-71; E. F. Benfield.

Paratypes. With same data as type, 103 adults; 42 adults from same county and stream as type but labeled as, 4 km downstream from U. S. 221 bridge west-northwest of Scottville; elevation 780 m above M.S.L.; 1-VI-72; E. F. Benfield. Paratypes are to be deposited in the United States National Museum of Natural History, Washington; the Illinois Natural History Survey, Urbana; Virginia Polytechnic Institute and State University, Blacksburg; and the Stovall Museum of Science and History, Norman, Oklahoma.

Other specimens examined. Several larvae were collected along with the adults, and although they will not be described here, series have been placed with the holotype and with the paratypes.

On page 684 of the monograph by Sanderson (1938) *S. gammoni* should key to *S. humerosa* at couplet 7. The key may be altered to include *S. gammoni* by deleting "*humerosa* Mots., 692" in the first half of couplet 7 and inserting 7′ as the guide:

7′. Elytral stripe usually entire; antennae and palpi light brown to testaceous .... *humerosa* Mots., 692.
Elytra bimaculate; antennae brown to black; palpi dark brown to black .... *gammoni* n. sp.

In the key by Brown (1972), the characters of *S. gammoni* are intermediate between *S. humerosa* and *S. mirabilis.* To avoid some ambiguity, couplet 34 (page 32) should be deleted and 2 couplets inserted as follows:

34(33). Elytral vitta usually entire, though somewhat clouded at middle; palpi testaceous; femora and tibiae entirely gray; 2.3-2.7 mm long, 0.95-1.1 mm wide (Fig. 46): .... *Stenelmis humerosa*
Elytra distinctly bimaculate; palpi dark brown to black .... 34′

34′(34). Femora gray, tibiae testaceous; 2.7-2.9 mm long, 1.1-1.2 mm wide (Fig. 47): .... *Stenelmis mirabilis*
Both femora and tibiae entirely gray; 2.29-2.43 mm long, 0.90-0.97 mm wide: .... *Stenelmis gammoni* n. sp.

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A NOTE ON *ARAEOCERUS PICIPES* ERICHSON

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The name *Lathropinus picipes* (Erichson) is listed in the Bernhauer and Schubert catalogue of Staphylinidae (1912:196) and in the Leng catalogue of Coleoptera (1920:100) as the only representative of that genus in America north of Mexico. In our recent catalogue of the Staphylinidae of America north of Mexico (Moore and Legner 1975) we have followed them in that regard.

Recently I examined 2 specimens collected by E. J. Ford at Shelltown, Md. on 4-11-65. These specimens are undoubtedly the same species but belong in the genus *Araeocerus* Nordmann.

A search of the literature reveals that Nordmann (1837:7) described the genus *Araeocerus* for a single species, *A. niger,* from Uruguay. Erichson (1840:671) described our Atlantic Coast species as *Pinophilus picipes.* Sharp (1886:620) called attention to the fact that *P. picipes* Er. belongs in *Araeocerus.* He was followed in this by Casey (1910:192). Why Bernhauer and Schubert (1912) and Leng (1920) placed it in *Lathropinus* is unknown.

Lathropinus is a Neotropical genus in which the middle tibiae have coarse long spines among the long fine pubescence. In *A. picipes* the middle tibiae are provided with long fine pubescence but are without coarse spines. *Araeocerus* is separated from *Pinophilus* in that the latter has a large central tooth on the inner edge of the mandible whereas the former has a small basal tooth. This is not a very satisfactory character for sorting specimens, as in most museum specimens the mandibles are closed so their inner margins are not visible. However, the 2 genera are readily separable because in *Araeocerus* the pronotum has a row of about 6 or 7 coarse punctures on each side of the midline, a similar row along the lateral margin, and as many more irregularly placed between; the surface otherwise is highly polished with numerous minute scattered punctulae. In *Pinophilus* the pronotum is densely punctured and often with dull ground sculpture.

As *A. picipes* must be removed from *Lathropinus,* that genus is without known species north of Mexico and should be omitted from our lists. Two other species of *Araeocerus* are listed from the United States, *A. obsidianus* Casey and *A. splendens* Fall, both from Texas.

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* * *

NEW RECORDS OF MEXICAN *TACHINUS* (COLEOPTERA: STAPHYLINIDAE)

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ABSTRACT

The male of *Tachinus inornatus* Sharp, a species previously known only from females, is described and illustrated from the state of Chiapas in Mexico. New distributional and habitat references are given for *Tachinus mexicanus* Campbell and *T. minor* Campbell. A key to all the known species of *Tachinus* from Mexico and Central America is included.

A number of specimens of *Tachinus* from Mexico, including males of a species previously known only from females, were recently sent for study by Dr. Alfred F. Newton, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts. I am indebted to Dr. Newton for sending me the material and for allowing me to retain specimens of the species for the Canadian National Collection, Ottawa.

Tachinus mexicanus Campbell

Tachinus mexicanus Campbell, 1973, p. 74.

New localities: MEXICO: *Jalisco:* E. slope Nevada de Colima, 8000 ft., IX-21-22-1973 (AN, CNC) 13. *Michoacán:* Cerro de Garnica, Pto. Garnica, 9400 ft., IX-17-18-1973 (AN, CNC) 2.

These specimens were collected from leaf litter on the forest floor and from gilled mushrooms. They are the first records of the species from the states of Jalisco and Michoacán.

Tachinus minor Campbell

Tachinus minor Campbell, 1975, p. 90.

New localities: MEXICO: *Mexico:* 4 mi. SW Tenancingo, 7200 ft., IX-11-1973 (AN, CNC) 3; 3 mi. SW Temascaltepec, 6700 ft., IX-14-1973 (AN) 1; 7 mi. NE Temascaltepec, 7000 ft., IX-12-15-1973 (AN) 1.

These specimens were collected from leaf litter on the forest floor, from soft mushrooms and coral fungi, and from soft fungi-gilled mushrooms and *Clavaria*. *Tachinus minor* was previously recorded from southeastern Arizona and Durango; the records from the state of Mexico represent a considerable southern extension of its known range.

Tachinus inornatus Sharp

Tachinus inornatus Sharp, 1883, p. 310; Campbell, 1973, p. 83.

This species was previously known only from 2 females collected at San Geronimo, Guatemala. I assigned the species to a monobasic species group (1973, p. 82) based primarily on the absence of pruinose spots on the abdomen. A series of specimens of this species collected from southern Mexico shows that the adults do have pruinose spots, but they are reduced and difficult to find unless the specimens are clean and well mounted. The discovery of the male of the species verifies the placement of the species in a group allied to the Fimbriatus group. The group is redefined as follows to include the additional variation and the characters of the male.

Redefinition of Inornatus group: Moderate in size, ranging in length from 4 to 5 1/2 mm. Surface of head and pronotum impunctate, with dense, coarse reticulate microsculpture. Maxillary palpus moderately long and slender; fourth segment 2 to 2 1/3 times longer than third segment. Antenna with segments 2 and 4 each distinctly shorter than segment 3. Abdomen with pruinose spots greatly reduced.

Male. Seventh sternite with apical margin moderately broadly, almost rectangularly emarginate, without rows of long spiniform setae; disc without rows of coarse granules along apical margin; disc evenly convex. Fifth and sixth sternites evenly convex. Eighth tergite with 4 short lobes.

Adults of this group may be distinguished by the greatly reduced pruinose spots of the abdominal tergites, by the lack of spiniform setae and only scattered granules on the male seventh sternite and by the almost rectangular emargination of the male seventh sternite.

Tachinus inornatus is redescribed as follows to include the additional variation and the characters of the male.

Description of *T. inornatus*: Dark brunneous; sides and base of pronotum, mouthparts, and legs testaceous. Body narrowly elongate oval with sides of abdomen gradually and evenly narrowed from base to apex. Length 4.2-5.5 mm.

Head, pronotum, and elytra with microsculpture consisting of small, coarse, slightly transverse, pentagonal cells; head and pronotum with punctation obscured by microsculpture; elytra with surface moderately finely, sparsely punctate. Head retracted into prothorax to level of posterior margin of eyes; eyes large, strongly convex; ocular seta lacking. Maxillary palpus long and slender; segment 4 with sides sub-parallel, 2 1/3 times longer than segment 3. Antenna with basal 2 segments lacking fine pubescence, segments 3 and 4 moderately densely pubescent, segments 5-11 very densely pubescent; ratio of lengths of segments as follows: 20:-12: 19: 13: 15: 15: 15: 15: 15: 15: 23; segment 5 elongate (l/w = 15/11), following segments gradually becoming broader approaching apex, segment 10 quadrate.

Pronotum 0.6 times as long as wide; apical margin broadly and shallowly emarginate; base truncate or slightly convex; sides broadly and evenly convex from base to apex, widest at basal third to fourth. Elytra, along suture, 1.2 times longer than pronotum at midline.

Abdomen with surface moderately coarsely, densely punctate; microsculpture dense, consisting of fine striae radiating from punctation; median pruinose spots of third and fourth tergites greatly reduced, visible only with high magnification and oblique lighting. Anterior tibiae slightly widened approaching apex, subequal in length to anterior femora.

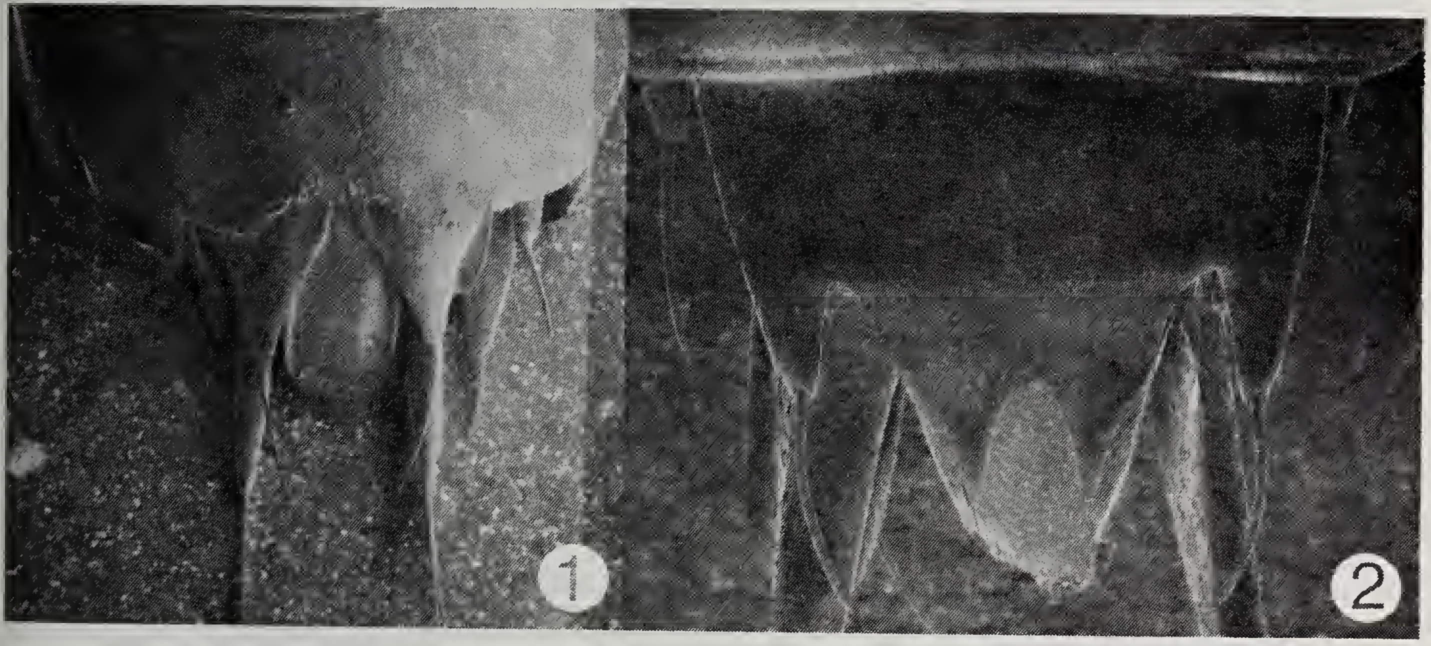
Male. Protarsi slightly widened. Seventh sternite (Fig. 1) with disc evenly convex; apical margin broadly, almost rectangularly emarginate; without long, spiniform setae; disc with a few scattered, fine granules near sides of emargination. Eighth sternite as in figure 1. Eighth tergite (Fig. 2) with 4 lobes; median lobes separated by a moderately broad, deep, U-shaped emargination; apex of each median lobe with a short seta, apex of each lateral lobe with a long macroseta. Genitalia (Fig. 3) with median lobe short and broad, much wider than lateral lobes; lateral lobes moderately long, narrow, with sides straight, gradually and evenly narrowed from base to apex; apices narrowly rounded; viewed laterally, lateral lobes slightly bent ventrally near middle, apices slightly hooked.

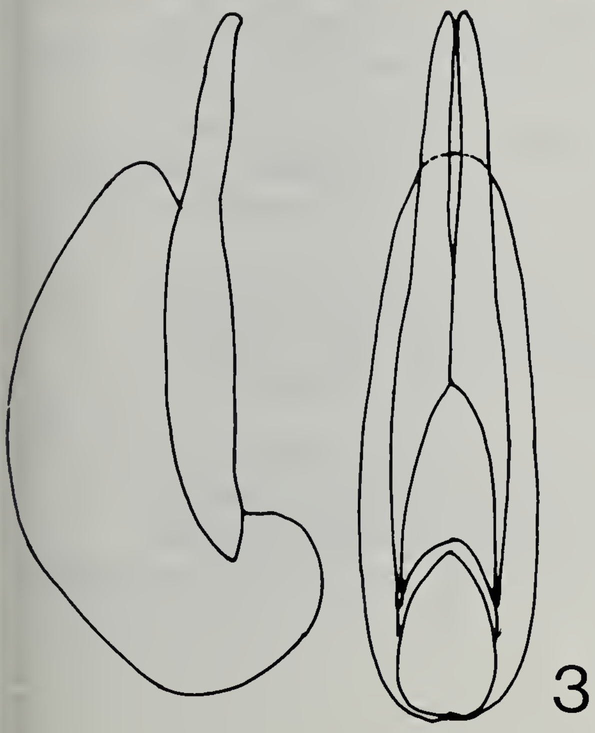
Female. See Campbell, 1973, p. 83.

New localities: Mexico: *Chiapas:* 8 mi. N. Pueblo Nuevo, Solistahuacán, 6000 ft., VIII-26-27-1973 (AN, CNC) 6; 3 mi N. San Cristobal, V-29-1969 (CNC) 1; 10 mi. NE San Cristobal, V-22-1969 (CNC) 1; near Tenejapa, 8 mi. NE San Cristobal, V-18-1969 (CNC) 1.

These specimens were collected from leaf litter on the forest floor, from soft, white, polypore combs, by sifting leaf litter along a small stream, and from mushrooms on the side of a log. These are the first records of this species from Mexico.

In the following keys, the figure numbers printed in bold faced type refer to those published in my 1973 revision.





Figs. 1-3, *Tachinus inornatus* Sharp, male: 1, ventral view of apex of abdomen; 2, dorsal view of apex of abdomen; 3, genitalia (left, lateral view; right, ventral view).

Key to Mexican and Central American species of *Tachinus*

Males

1. Apical margin of seventh sternite with a partial row of fringing, spiniform setae (**Fig. 81**) .... *T. oaxacensis* Campbell

1′. Apical margin of seventh sternite lacking rows of spiniform setae 2

2(1′). Surface of pronotum and elytra strongly shining, without microsculpture .... *T. minor* Campbell

2′. Surface of pronotum and elytra with distinct striate or reticulate microsculpture 3

3(2′). Pruinose spots of abdomen greatly reduced (visible only with magnification of approximately 100X); microsculpture of pronotum reticulate .... *T. inornatus* Sharp

3′. Pruinose spots of abdomen visible with low magnification (10X); microsculpture of pronotum transversely striate 4

4(3′). Seventh sternite (**Fig. 54**) deeply, rather narrowly emarginate, with 3 patches of granules, one at base and one on each side of emargination; known only from Panama .... *T. meridionalis* Sharp

4′. Seventh sternite (**Figs. 53, 78**) more broadly and shallowly emarginate, with one band of granules on disc adjacent to emargination; known from Mexico and Guatemala 5

5(4′). Coarse granules of seventh sternite (**Fig. 53**) restricted to a single row along apical margin; lateral lobes of male genitalia (**Fig. 127**) strongly hooked apically .... *T. alticola* Sharp

5′. Coarse granules of seventh sternite (**Fig. 78**) denser, arranged in a zone adjacent to apical margin; lateral lobes of male genitalia (**Fig. 126**) deflexed apically .... *T. mexicanus* Campbell

Females

6. Pruinose spots of abdomen greatly reduced (visible only with magnification of approximately 100X); microsculpture of pronotum reticulate .... *T. inornatus* Sharp

6′. Pruinose spots of abdomen visible with low magnification (10X); microsculpture of pronotum absent or transversely striate 7

7(6′). Surface of pronotum and elytra strongly shining, without microsculpture .... *T. minor* Campbell

7′. Surface of pronotum and elytra with distinct transversely striate microsculpture 8

8(7′). Emargination of median lobe of eighth tergite reaching to base of lobe (**Figs. 28a, 47a, 49a**); emargination between fimbriate lobes of eighth sternite evenly convex at base (**Figs. 28b, 47b, 49b**) 9

8′. Emargination of median lobe of eighth tergite (**Fig. 25a**) shallower, not reaching to base of lobe; emargination between fimbriate lobes of eighth sternite with a distinct tooth at base (**Fig. 25b**) .... *T. mexicanus* Campbell

9(8). Pronotum and elytra flavous with a large, triangular, piceous area extending from apical angles of pronotum to apex of elytral suture; known only from Panama ...... *T. meridionalis* Sharp

9′. Pronotum and elytra brunneous to black; frequently with some or all of pronotal and elytral margins paler, but without a large, distinct, triangular piceous area; known from Mexico and Guatemala 10

10(9′). Elytra with punctures coarse and deeply impressed, separated by average distance distinctly less than diameter of a puncture; surface between punctures smooth and strongly shining with microsculpture almost completely obsolete .... *T. oaxacensis* Campbell

10′. Elytra with punctures moderately finely and shallowly impressed, separated by average distance approximately equal to diameter of a puncture; surface between punctures slightly shining with distinct microsculpture .... *T. alticola* Sharp

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BOOK REVIEW

Insect ecology, by Peter W. Price. 1975. John Wiley & Sons, Inc., 605 Third Ave., N. Y., N. Y. 10016. Hardbound, 514p., $15.95.

So many general ecology textbooks have been published during the past decade that it is a real pleasure to have one appear on insect ecology. Although written for advanced undergraduates and graduate students in entomology, it undoubtedly will be used as a reference by both amateur and professional entomologists. The volume is divided into 4 parts; Part I Trophic Relationships, Part II Populations, Part III Coexistence and Competition, Part IV Communities and Distributions. There is a Taxonomic Index, an Author Index, a Subject Index, and an excellent Bibliography. The text is easy to read and is a definite contribution.

—Paul P. Shubeck

BOOK REVIEW

An introduction to the study of insects, 4th Edition, by Donald J. Borror, Dwight M. DeLong, & Charles A. Triplehorn. 1976. Holt, Rinehart & Winston, 383 Madison Ave., N. Y., N. Y. 10017. Hardbound, 852p., $19.95.

This highly respected text and reference book on insects contains a number of interesting changes in this latest edition. The cover is much more attractive. The overall size has been reduced so that the book is easier to handle and to use. A third author has been added, and he has revised the chapter on Coleoptera (including the key) as well as the chapter on Collecting, Preserving, and Studying Insects. References have been updated, and a new chapter on Insect Behavior is included. Instructors of traditional introductory entomology courses should find this a very suitable textbook.

—Paul P. Shubeck

BOOK REVIEW

Insects—Instructions for collectors No. 4a, by B. H. Cogan & K. G. V. Smith. 1974. British Museum (Natural History), London. Durable softcover, 169p., $1.50.

This is a complete revision of the original edition which was authored by John Smart and published in 1940. Much general collecting information as well as specific collecting information for each order is presented. Eight pages are devoted to Coleoptera. This is a very useful volume at a very reasonable price.

—Paul P. Shubeck

PHANAEUS DIFFORMIS LECONTE (COLEOPTERA: SCARABAEIDAE): CLARIFICATION OF PUBLISHED DESCRIPTIONS, NOTES ON BIOLOGY, AND DISTRIBUTION IN TEXAS

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Abstract

A clarification of published descriptions of *Phanaeus difformis* LeConte is presented. The species is found statewide and prefers, but is not restricted to, sandy soils in open pastures. It is primarily coprophagous and is attracted to swine and human feces. Field studies indicate that activities of the species (burrowing, nidification) parallel those of *P. vindex* MacLeay. In the laboratory, an average of 1 egg ball (ca. 32.4 gr each), was constructed every 8 days. Development time (egg to adult) was 6 to 12 months. Adults survived a maximum of 473 days. As determined by laboratory studies, color in this species seems to be genetically controlled.

The genus *Phanaeus* MacLeay forms an important part of the dung beetle fauna throughout much of the Western Hemisphere. The morphological study by Edmonds (1972) has provided needed information regarding this group. In Texas, the genus is represented by 4 species: *P. difformis* LeConte, *P. vindex* MacLeay, *P. triangularis* Say, and *P. torrens* LeConte. Because of the close, possibly sibling, relationship of *P. difformis* and *P. vindex* (noted by Woodruff [1973]) and since the study by Lindquist (1933) appears to be the only published biological data on *P. difformis,* extensive observations were made at several locations in the field and at the Veterinary Toxicology and Entomology Research Laboratory, College Station, Texas, in an effort to provide useful data regarding this species.

Published descriptions (LeConte 1847:86, Blanchard 1885:168, and Olsoufieff 1924:96, *P. difformis*; and Robinson 1948:302, *P. d. difformis*) of this highly variable species are inadequate for comparative purposes. LeConte's description applies only to the blue color phase of the species, and the descriptions by Blanchard, Olsoufieff, and Robinson are incomplete. Therefore, the following additions to published descriptions are offered.

Description: (Fig. 1 and 2). Rather large, robust beetles. Males average 19.4 mm in length (range 22 to 15 mm) and 11.6 mm in width (range 14 to 9 mm). Measurements of females indicate no significant differences in length or width from values given for males. Either sex may be of one of the following two color phases: shining, dark-green elytra, prothorax red dorsally shading to dark-green at the edges; or bright, deep-blue elytra, prothorax brassy or golden-green dorsally shading to deep-blue at the edges. Large series of specimens (> 100) collected at various sites indicate that ca. 1/4 of individuals in populations of this species display blue coloration. Some specimens are intermediate in color between these extremes.

Elytra in both sexes are prominently striated, the intervals reticulately punctate; intervals 1 and 2 may, or may not, be costate for varying parts of their length. Well-developed, "major" males have an erect cephalic process, or horn, arising medially on the head and curving backward over the prothorax; less well-developed, "minor" males have a much shorter horn. The disc of the pronotum in major males is flattened dorsally and is flared inward at the posterior angles; this specialization may be greatly reduced in minor males to such an extent that the pronotum has only two small protuberances. The cephalic process in females is a short, apically truncate projection and is much less variable in length than that of males. The pronotum of the female (viewed dorsally) bears a concave, transverse ridge.

Distribution in Texas: (Fig. 3). Although generally considered a western species, *P. difformis* is widely distributed throughout the state. With the exception of the lower Gulf Coast, its range overlaps that of *P. vindex* at about 98° longitude. The lack of collection records in the western part of the state (Fig. 3) is due, in part, to a lack of collecting rather than an actual absence of this species.

Field Biology: The observations upon which the following discussion is based were made during 1970-74 at sites in Gillespie, Kleberg, Robertson, and Victoria Counties. The species is diurnal and primarily coprophagous and has a marked preference for swine and human feces, a characteristic shared with many other coprids (Fincher, et al. 1970, 1971; Stewart, 1967). We routinely use swine feces as a bait in pitfall traps used for surveying populations of dung beetles. In eastern Texas where both *P. difformis* and *P. vindex* inhabit the same general area, *P. difformis* occupies areas having very sandy soils in pastures having an open, bunchgrass type of cover. *P. vindex,* on the other hand, occupies areas with heavier loam to

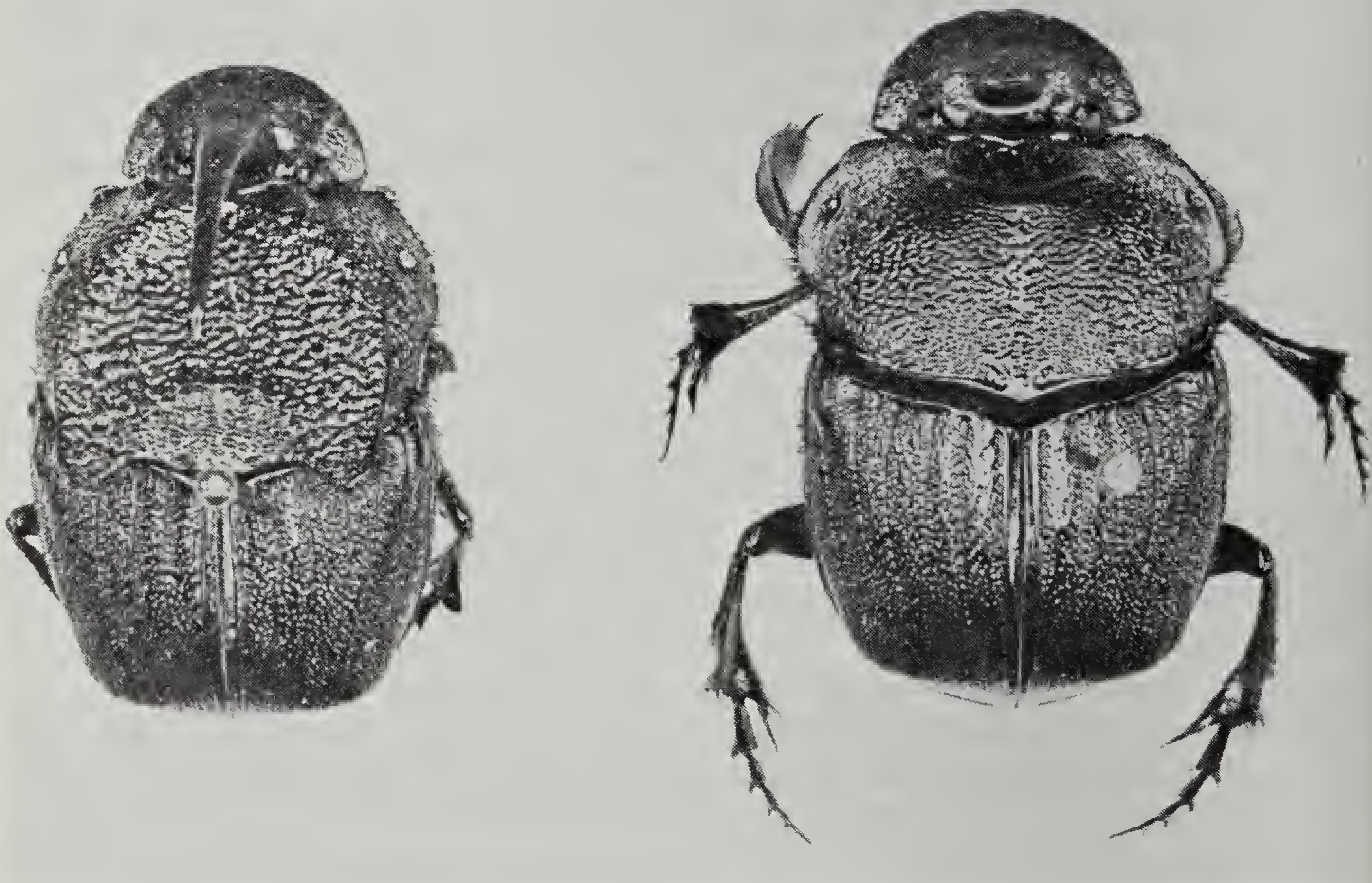

Fig. 1. *Phanaeus difformis,* dorsal views: male left, female right, ca. X 2½.

clay-loam soils supporting dense sod. Adult abundance, activity, and duration (length) of immature stages depend upon soil type, temperature, and precipitation; extremely hot, dry weather causes decreased activity, the same being true of excessively wet, cold conditions. Beetles have been observed during all months of the year; however, adult activity ceases about the end of November and begins about the beginning of April in south Texas. In more northerly areas activity ceases about a month earlier and begins about a month later. There appear to be 2 generations, or broods, each season and 3 periods of adult activity. A major peak of activity occurs about the first of April followed by a less pronounced peak in June; the 3rd period, at least as pronounced as the 1st, occurs in September or October.

Upon emergence the adults undergo a period of feeding and maturation, the "reifungsfrasse" referred to by Halffter and Matthews (1966) and others. In *P. difformis* this period lasts 2 to 3 months. Food seeking, feeding, and nidification behavior are very similar to that described for *P. vindex* by Fincher (1972) and for *P. triangularis* by Lindquist (1935). Flight is rapid, usually into the wind, and in a zig-zag pattern at a height of 1 to 1½ m above the ground. On sensing a food source, the beetle assumes a circling pattern (presumably to locate the food source) and finally alights near

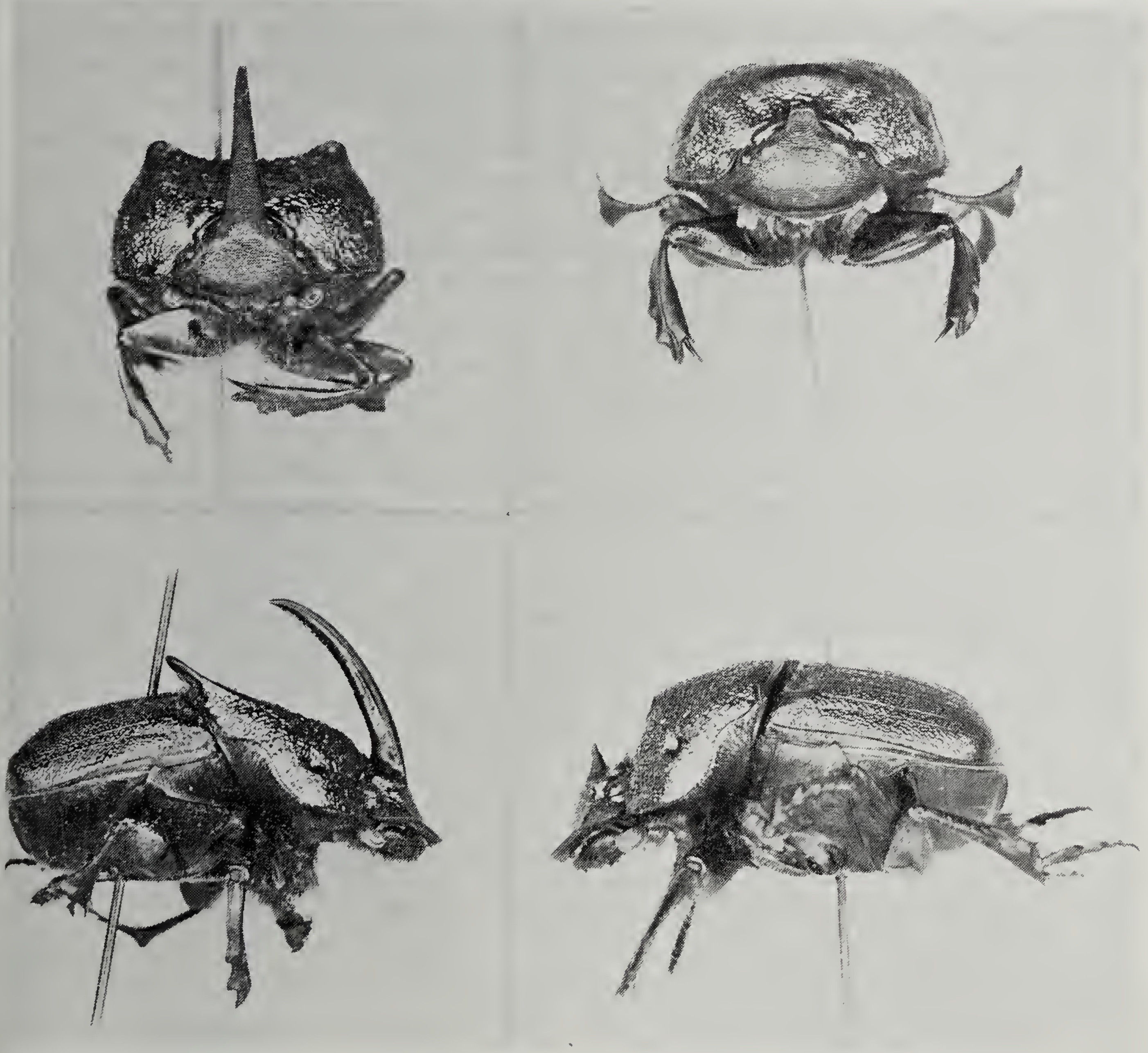

Fig. 2. *Phanaeus difformis*: Frontal view, male, upper left; frontal view, female, upper right; lateral view, male, lower left; lateral view, female, lower right, ca. X 2½.

(within 1 or 2 m) or directly on the food. The beetle immediately burrows under the food and construction of a burrow begins. Either a feeding burrow or a nidification burrow may be constructed. In each, the entrance of the burrow is either beneath or in contact with the edge of the food source. For several members of the genus, Halffter and Matthews (1966) and Halffter *et al.* (1974) reported food transportation by means of pushing or butting with the head and forelegs, followed by construction of a burrow at a distance from the food source. We have not observed this type of behavior in *P. difformis.* Feeding burrows may be constructed by either sex (only 1 beetle usually is found in these burrows) and are usually shallower and at a more oblique angle in relation to the food source than are nidification burrows. Manure is packed into these burrows in rod-like masses that may be 5 to 10 cm in length. Construction of nidification burrows may be initiated by 1 beetle of either sex and is completed as a cooperative effort by a pair (1 male, 1 female). Depending on soil type these burrows may be 15 to 30 cm in depth. At the end of the burrow, a chamber is enlarged and the egg ball is constructed by the female from manure brought by the male. Construction and shape of the egg balls are the same as has been described for numerous other members of the genus by Halffter and Matthews (1966), Fincher (1972), and Lindquist (1933, 1935). We have not observed copulation in *P. difformis* but assume that it takes place in the burrow in the presence of the egg ball. Upon completion of the egg ball, the burrow is sealed with soil and is left unattended.

The rate of development of immature stages depends upon temperature and soil moisture and thus is quite variable. However, eggs laid in the

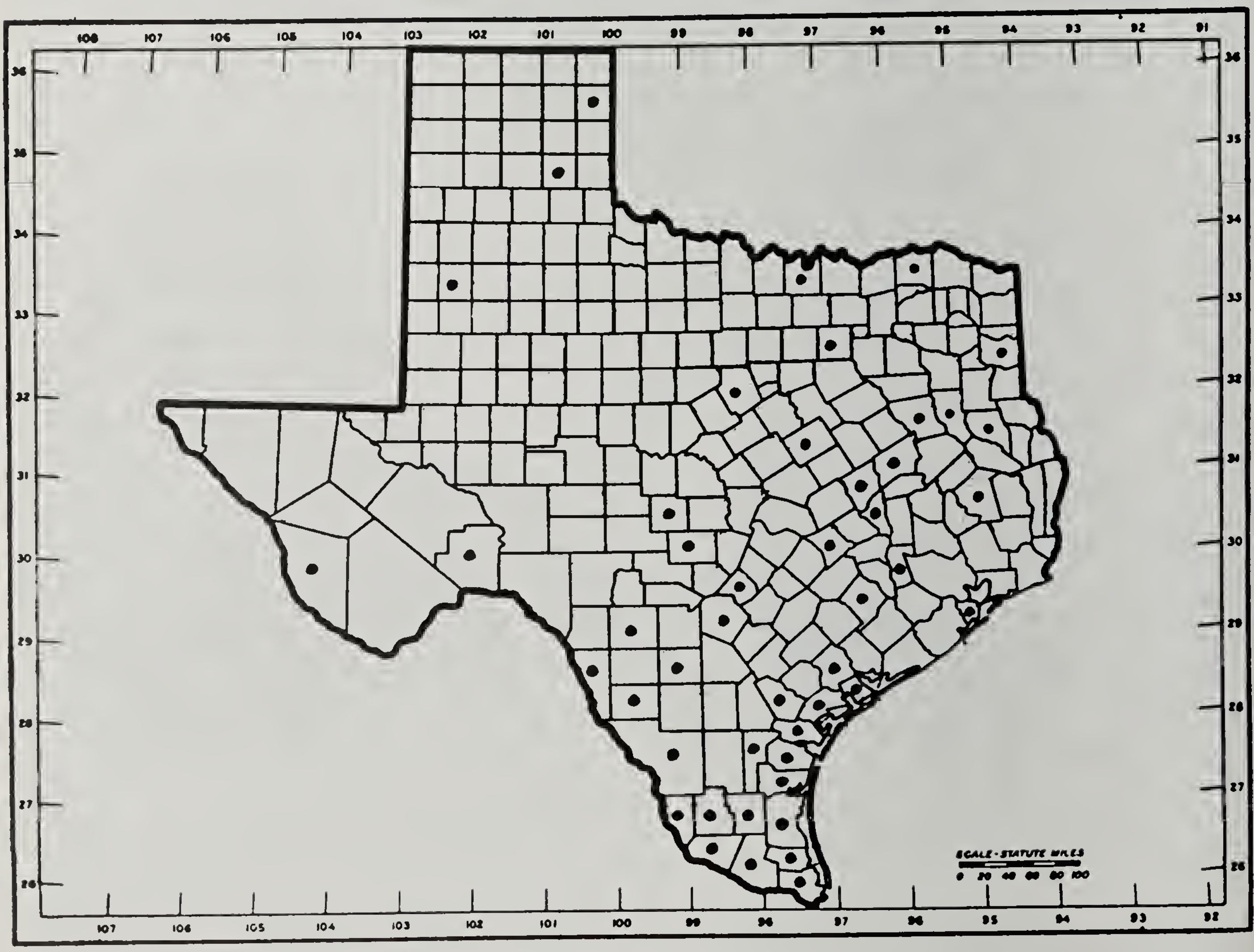

Fig. 3. Distribution of *Phanaeus difformis* in Texas.

spring usually produce adults in the fall (September or October), whereas eggs laid in the fall do not produce adults until the following spring. Overwintering occurs both in the adult and larval stage. The length of adult life can be in excess of 1 year, but it is expected that most adults do not attain this age.

Laboratory Biology: Two lines of study were pursued: (1) investigation of the life cycle of *P. difformis,* including fecundity and quantities of manure buried; and (2) attempts to clarify questions relating to color in *P. difformis.*

All laboratory observations were made in aquaria (ca. 38 L. capacity). Twelve aquaria were each filled to a depth of ca. 17.5 cm with a soil mixture consisting of 2 parts loam, 1 part sand, and 1 part peat moss. Bovine feces used for food and for nidification were obtained from animals fed a mixture of alfalfa and bermuda grass hay. Fresh feces were placed in each aquarium twice weekly. Each aquarium was completely emptied each month in order to replenish soil moisture. Temperature in the insectary was maintained at ca. 25°C. Since the insectary was illuminated by daylight entering windows, the beetles were under normal photoperiod throughout the year.

Colonization began in 1972. Because of the possible close relationship of *P. difformis* and *P. vindex,* beetles selected initially for study were obtained from areas of the state where only one species, or the other, were found. In addition, only "major" males and females were used.

The period of feeding and maturing (*reifungsfrasse*) was ca. 2 months after which the beetles, 1 male and 1 female per aquarium, constructed egg balls more or less continuously for the remainder of their life. One pair, observed for 9 months, constructed 33 egg balls (an average of 1 egg ball every 8.3 days). A 2nd pair, observed for 6 months, produced 20 egg balls (1 egg ball each 9.0 days). A 3rd pair produced 52 egg balls in a period of 13 months (1 egg ball each 7.9 days). The maximum number of egg balls produced by a pair during a 30-day period was 9 (1 egg ball each 3.3 days). The average weight of 108 egg balls was 32.4 gr (range 18.0 to 60.0 gr). The diameter of these balls averaged 37.2 mm (range 29.0 to 43.0 mm). The egg balls are pyriform, having a hard coating of soil ca. 3 to 5 mm in thickness. The eggs are laid in a small chamber at the top of the ball that was separated from the mass of manure by a thin layer of soil. Brood balls were removed from the aquaria at regular intervals and were placed in soil-filled containers until emergence. The developmental time (egg to adult) apparently is quite variable. One group of 20 egg balls formed during the same 30-day period produced the following results:

Percent of 20 brood balls	Months required for development
5	6
10	7
10	8
35	9
15	10
20	11
5	12

These data, plus many additional observations, appear to indicate that whereas the developmental period (egg to adult) may be as short as 6 months or as long as 12 months, the period of greatest emergence occurred between the 9th and 11th months. Fincher (1972) reported that the size of the emerging *P. vindex* adults apparently had no relationship to the size of the egg ball (food available to the larvae). Our observations indicate that this is also true for *P. difformis*. Adults lived for a maximum of 473 days in the insectary.

Color variation was studied by matching various combinations of green and/or blue males and females. The soil mixture used in the aquaria was the same as described above, for all matings. Also, the feces provided the beetles were obtained from one animal. Initial laboratory studies with field collected, green adults supported our observations (made in the field) that ca. 1/4 of *P. difformis* adults display the blue coloration. Of 20 adults that emerged from a group of egg balls formed in the laboratory by green parents between October 1972 and April 1973, 5 (exactly 25%) were blue. When laboratory reared blue males and females were mated, we were able to rear 24 adults from 40 brood balls. Seventeen (70.8%) of these adults were blue. Admittedly, the amount of data regarding color that we have been able to gather is small. However, we feel justified in suggesting that color in this species is controlled by genetic factors.

ACKNOWLEDGMENTS

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CORRECT VALIDATION OF THE GENERIC NAME *ACALLEPITRIX* BECHYNÉ 1959 (CHRYSOMELIDAE: ALTICINAE)

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A nomenclaturally acceptable proposal of the neotropical genus *Acallepitrix* by Bechyné in 1959 (7) was preceded by 2 nomenclaturally unacceptable proposals of the generic name and by several new combination proposals and new species descriptions.

Both generic descriptions (2,3) published prior to 1959 are invalid because they lack the original designation of a type-species required by the International Code of Zoological Nomenclature (I.C.Z.N.) for new nominal genera proposed for more than one included species after 1930. In 1959 (7), "*Acallepitrix* n.gen." was proposed, accompanied by a type-species designation: "Generotypus: *Chalcoides erichsoni* Jac.". Specific names proposed (1,2,3,6) before 1959 in *Acallepitrix* are available even though published in combination with a generic name unavailable at the time of their description [I.C.Z.N. Art. 17(3)]. As for species (1,3,4) transferred from other genera before 1959 to the then unavailable *Acallepitrix,* we can accept Bechyné's referrals.

Two Bechyné papers published after the valid 1959 description contain differing citations to the place and date of publication of *Acallepitrix.* In 1963, Bechyné and Bechyné (11) correctly cited the 1959 description (7) of the genus. However, in 1970, Bechyné (8) cited the 1957 reference (3) as the valid description of *Acallepitrix* and designated one of the included species (*Crepidodera coracina* Boheman 1859) as type. *This was incorrect.* The 1959 description of the genus *Acallepitrix* satisfies the rules of nomenclature of the I.C.Z.N. with regard to description of a genus and designation of a type-species after 1930. *Chalcoides erichsoni* Jacoby 1902 is thus the type species of the genus *Acallepitrix,* by original designation.

ACKNOWLEDGEMENTS

My thanks to C. W. Sabrosky, United States Department of Agriculture, Washington, D. C., and A. R. Hardy, California Department of Food and Agriculture, Sacramento, CA, for clarification of several nomenclatural aspects of this review.

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* * *

NEW SPECIES OF THE GENUS *SCIATROPHES* BLACKBURN FROM ARIZONA (COLEOPTERA: SCAPHIDIIDAE)

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ABSTRACT

The following 2 species of *Sciatrophes* Blackburn (Scaphidiidae), both from Arizona, are described as new: *S. flagellata* (Pinaleno Mts., Chiricahua Mts., and Huachuca Mts.), and *S. valida* (Pinaleno Mts.). *Baeocera irregularis* Champion 1913, here transferred to *Sciatrophes* Blackburn, is reported from the United States for the first time.

Among the numerous scaphidiids collected by Dr. Ales Smetana, Ottawa, in the mountains in southeastern Arizona, of special interest are specimens of 3 large, conspicuous species of the genus *Sciatrophes*. Two of these species, *S. flagellata* n. sp. and *S. valida* n. sp., belong to the *congener*-group. This group includes some species which are difficult to distinguish; since Cornell (1967) overlooked important taxonomic characters, re-examination of the type-material of several species of this group was necessary.

The genus *Sciatrophes* is better known as *Eubaeocera* Cornell or *Baeocera* Erichson. Cornell's placement of *Baeocera* Erichson in synonymy with *Cyparium* Erichson and consequent replacement of the former by *Eubaeocera* was incorrect. The type species of *Baeocera* is by monotypy *Scaphidium concolor* F., a senior synonym of *Cyparium flavipes* LeC. (Achard 1920:307). The original material of *S. concolor* is apparently lost, but a specimen named by Erichson as *Baeocera concolor* and another from Mexico mentioned by Erichson as related to *B. concolor* are preserved in the Berlin Museum. They agree well enough with published data to prove that Erichson (1845:4) misidentified the species in question, although the former specimen was carelessly dissected and is in very poor condition; both are very distinct from *Cyparium*, the former most probably and the latter indubitably congeneric with species placed in *Eubaeocera*. Therefore it would have been better to apply the Code (article 70, a ii) than to establish the new name *Eubaeocera*, which is a subjective junior synonym of *Sciatrophes* Blackburn (Löbl, 1977). I referred this case to the Commission; awaiting its judgement I use *Sciatrophes* as the valid name.

The following abbreviations as used in the text refer to the material studied:

CNC = Canadian National Collection, Ottawa, Canada
MG = Muséum d'Histoire naturelle, Geneva, Switzerland

The length of each species is measured from the middle of the apical pronotal margin to the inner apical angle of the elytra. The 1st visible abdominal sternite is considered as the 1st sternite.

I wish to thank my colleagues Dr. K. V. Krombein and Dr. T. L. Erwin (The United States National Museum of Natural History, Smithsonian Institution, Washington, D.C.) for allowing me to examine the type-material I needed for this study. I also wish to thank my friend, Dr. A. Smetana, Entomology Research Institute, Ottawa, for submitting material for study and for letting me retain several of these specimens from the material studied.

Sciatrophes flagellata Löbl, **new species**

Very similar to *S. securiforma* (Cornell) externally. Black or brownish-black. Antennae as in Fig. 1. Pronotum at base 1.31-1.41 mm wide, microsculpture usually somewhat less distinct than in *S. securiforma*. Elytra at suture 1.46-1.63 mm long, at widest point together 1.48-1.61 mm wide; elytral punctation somewhat coarser than in *S. securiforma*. Pygidial punctation finer and sparser than in *S. securiforma*. Metepisterna narrower, at widest point hardly 0.09 mm wide, straight and narrowed proximally, punctation of inner suture denser. Middle portion of metasternum somewhat more convex. Tibiae stouter; mesotibiae 0.61-0.67 mm long, somewhat curved; metatibiae 0.80-0.88 mm long, slightly curved. Metatarsi 0.51-0.54 mm long. *Male*:

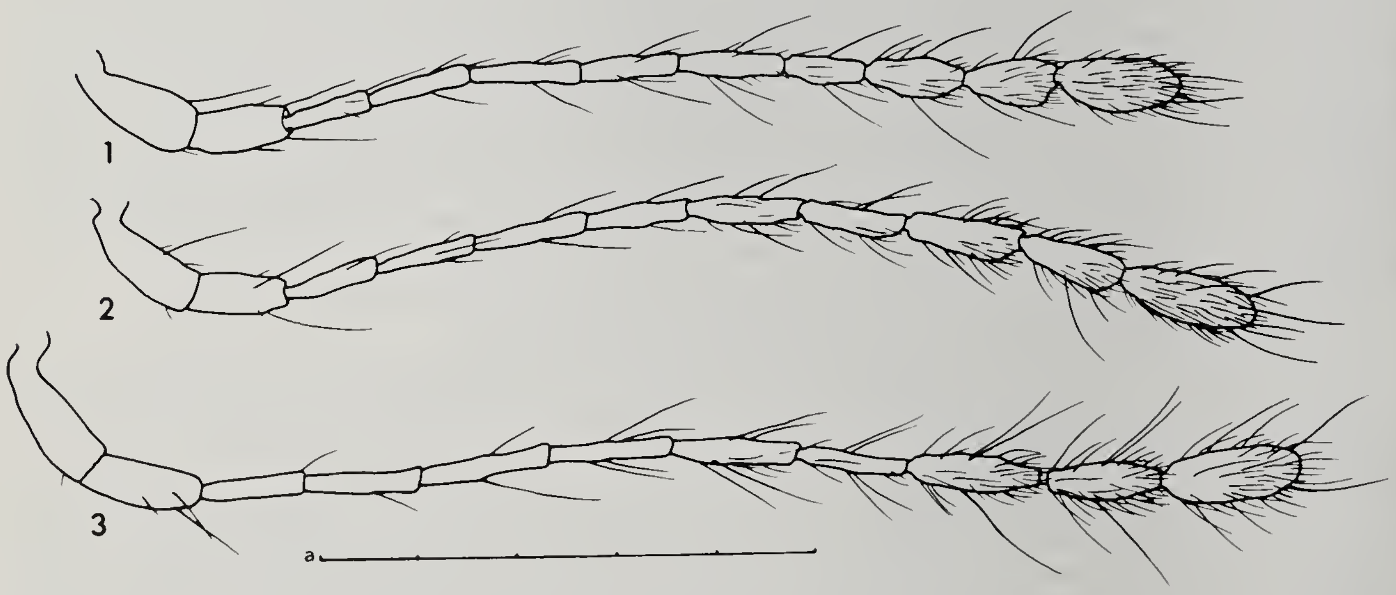
Segments 1-3 of protarsi and segments 1-2 of mesotarsi strongly enlarged; apical margin of sixth sternite (Fig. 4) strongly produced medially (not so in *S. securiforma*); aedoeagus as in Figs. 7 and 8, strongly sclerotized, 1.23-1.26 mm long. *Length* 2.4-2.55 mm.

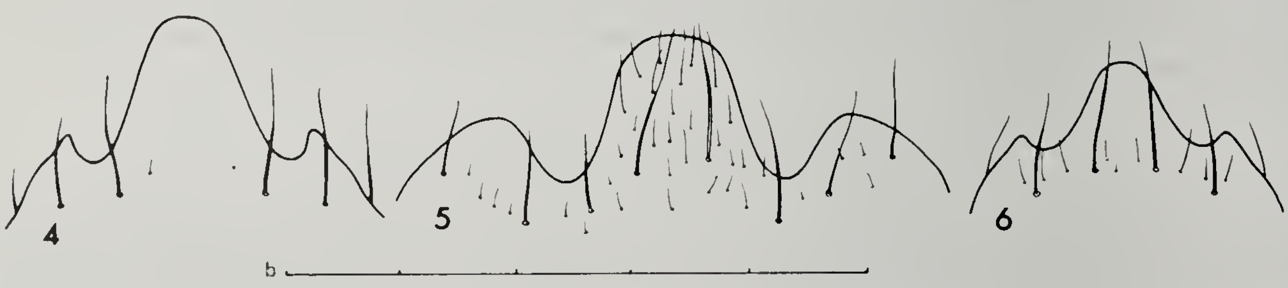
Type-material. Holotype (male): Arizona: Graham Co., Pinaleno Mts., Wet Cn, 6100′, 29-VII-69, A. Smetana coll. In the Canadian National Collection, Ottawa (CNC No. 13087). *Paratypes*: same data as holotype, 2 males, 9 females (CNC, MG); Pinaleno Mts., Turkey Flat, 7200′, 27-VII-69, 1 female (CNC); Chiricahua Mts., East Turkey Crk., 7 mi W Portal, 22-VII-69, 3 males, 4 females (CNC, MG); Cochise Co., Huachuca Mts., Miller Cn., 5500′, 1-VIII-69, 1 male, 2 females (CNC, MG); same data, 6500-7000′, 1 female (MG).

Bionomics. The series from Wet Cn., Pinaleno Mts., was collected by sifting very deep, moist, and partially mouldy layers of rotten leaves accumulated at the base of high vertical rock walls. The remaining specimens were mostly taken by sifting deeper and more or less wet layers of fallen leaves on the forest floor.

Discussion. *Sciatrophes flagellata* belongs to the *congener*-group which previously included 5 species: *S. deflexa* (Casey), *S. congener* (Casey), *S. securiforma* (Cornell), *S. youngi* (Cornell) and *S. cerbera* (Cornell). The aedoeagus of *S. flagellata* which is similar in structure to that of *S. deflexa* but differs drastically from those of the other 4 species. In *S. deflexa,* however, the parameres are shorter and expanded in basal half (lateral view), the median lobe is only slightly produced above the base of the paramere, and the sclerites of the internal sac, especially the flagellum, are differently shaped. *S. deflexa* is distinguished from all other species of the group by the form of the elytral sutural stria, which is reduced in front and therefore not connected with the lateral stria.

In all specimens of *S. flagellata* and *S. securiforma* examined, the scutellum is completely covered by the pronotum. Cornell (1967:4, 13) described the scutellum as visible and wide in *S. securiforma,* but after I cleaned the surface of the holotype (the species was described from a single specimen) the apparent outlines of the scutellum disappeared.





Figs. 1-3, Antennae: 1, *Sciatrophes flagellata* n. sp., paratype from East Turkey Crk.; 2, *S. valida* n. sp., paratype from Wet Cn.; 3, *S. irregularis* (Champ.), from Ash Cn.; scale a = 0.5 mm.

Figs. 4-6, Sixth male sternite: 4, *S. flagellata,* paratype from East Turkey Crk.; 5, *S. valida,* paratype from Wet Cn.; 6, *S. irregularis,* from Ash Cn.; scale b = 0.5 mm.

Sciatrophes valida Löbl, **new species**

Rather similar to *S. securiforma* externally. Black or brownish-black; elytra often paler, apical half usually dark brown. Antennae as in Fig. 2. Pronotum at base 1.26-1.34 mm wide; lateral margins near basal angles straight, convergent proximally; apical pronotal margin comparatively wide; apical marginal stria complete, deepened behind angles; pronotal surface without microsculpture, punctation somewhat more distinct than in *S. securiforma*. Apical portion (rarely only apical margin) of scutellum visible. Elytra at suture 1.42-1.54 mm long, at widest point together 1.44-1.56 mm wide, their contours as in *S. deflexa* widened distally in basal fourth, then straight and feebly narrowed towards apical third, in apical third more distinctly narrowed, almost straight and convergent towards apex; sutural margin in front not or hardly elevated; interval between suture and sutural stria flat, bearing rather irregular row of punctures; sutural stria as in *S. securiforma,* connected with lateral stria in front but more densely and coarsely punctate; elytral punctation coarser than in *S. securiforma*. Pygidium as in *S. flagellata,* punctation sparser and finer than in *S. securiforma*. Mesepimera slightly more than twice as long as distance between them and mesocoxae. Smooth middle portion of metasternum narrower than in *S. securiforma,* bordered both laterally and posteriorly by dense, coarse punctation; mediodistal metasternal impressions very shallow; metasternal margin between metacoxae straight, punctation of lateral portions of metasternum very fine. Metepisterna convex, at widest point up to 0.14 mm wide, slightly and gradually narrowed proximally; inner metepisternal suture deep and furrowlike, not punctate, rounded apically, otherwise straight. First sternite with a basal row of oblong punctures, surface without microsculpture, very finely punctate. Meso- and metatibiae stout (as in *S. securiforma*) and somewhat curved; mesotibiae 0.61-0.69 mm, metatibiae 0.77-0.85 mm long. Metatarsi 0.58-0.65 mm long. *Male*: Tarsal segments enlarged in similar way as in *S. flagellata*; apical margin of sixth sternite as in Fig. 5; aedoeagus (Figs. 9 and 10) 1.18-1.26 mm long, strong, sclerites of internal sac very strongly sclerotized in part. *Length* 2.25-2.40 mm.

Type-material. Holotype (male): Arizona: Graham Co., Pinaleno Mts., Wet Cn., 6100′, 29-VII-69, A. Smetana coll. In the Canadian National Collection, Ottawa (CNC No. 13088). *Paratypes*: same data as holotype, 5 males, 3 females (CNC, MG).

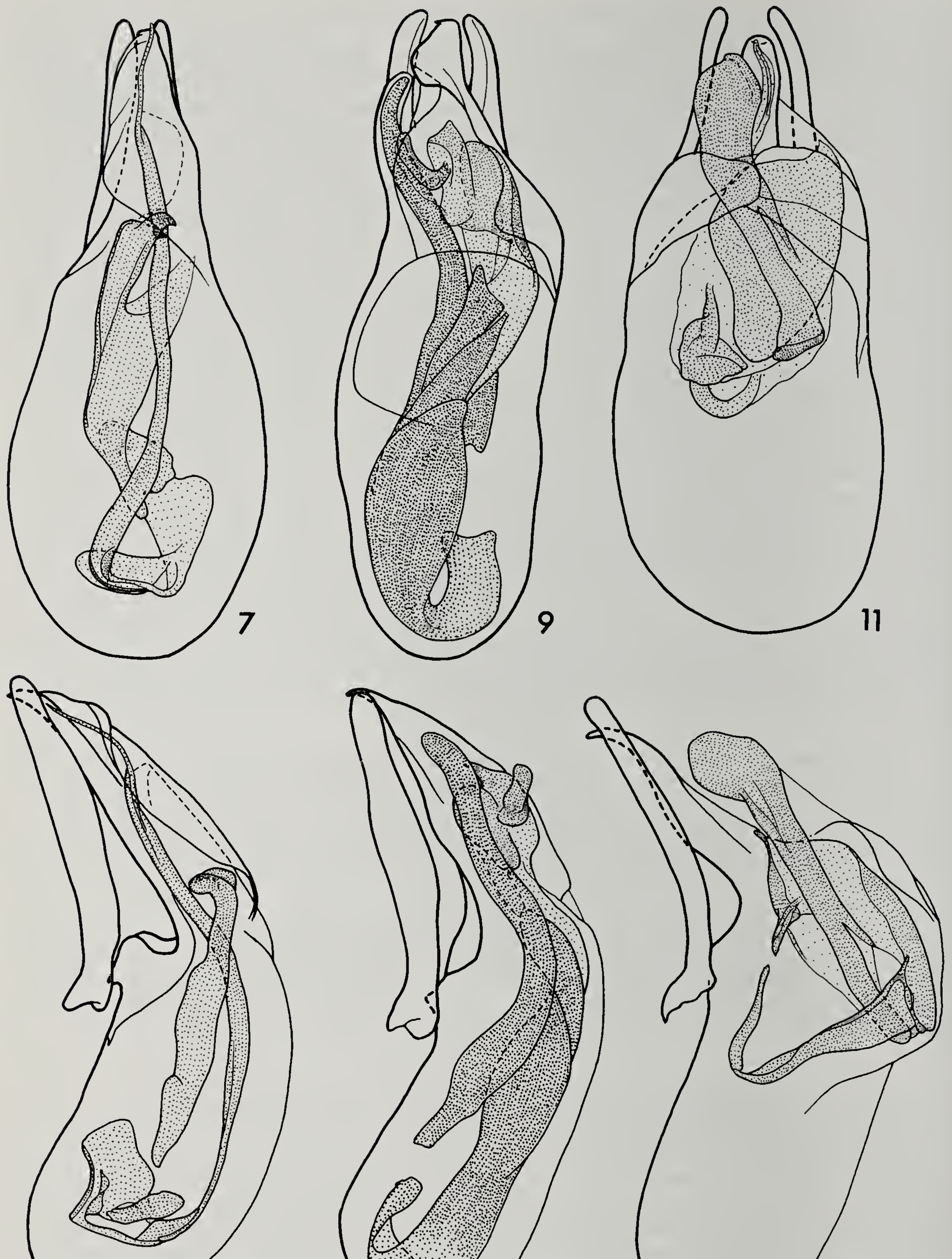
Bionomics. All specimens of the original series were collected together with *S. flagellata* by sifting deep, moist, and partially mouldy layers of rotten leaves accumulated at the base of high vertical rock walls.

Discussion. *S. valida* is well characterized among related species by the shape of male copulatory organ. In external characters it differs from *S. securiforma* mainly by the pronotal surface which lacks microsculpture, by the partially visible scutellum, by the shape of the elytra, and by the different punctation of the pygidium, metasternum, and elytra. It differs from *S. flagellata* by the more slender tibiae and longer metatarsi, less distinctly by the different punctation of the body surface.

Sciatrophes irregularis (Champion), **new combination**

Baeocera irregularis Champion 1913:70. Holotypus female: Mexico, Omilteme (British Museum, Natural History, London).

Form strongly convex. Head and pronotum black or brownish-black, pronotal base in specimens from Arizona more or less dark reddish, elytra dark brown or dark reddish-brown, legs paler reddish-brown. Antennae as in Fig. 3. Pronotum at base 1.16-1.20 mm wide, strongly narrowed in front, apical margin of pronotum less than half as wide as basal margin; lateral margins rather evenly rounded; lateral keel in dorsal view complete (holotype), or obsolescent except for short middle portion (Arizona specimens); stria of apical margin fine and complete; pronotal surface without microsculpture, punctation very fine, barely visible at magnification 25 times. Scutellum completely covered by pronotum. Elytra at suture 1.38-1.48 mm long, at widest point together 1.32-1.38 mm wide, widened distally in basal fourth, more or less parallel-sided at middle, slightly narrowed behind middle, distinctly narrowed in apical third to rounded apical margin; interval between suture and sutural stria strongly angularly elevated (holotype) or almost flat with sutural margin slightly raised; row of punctures laterad to sutural margin fine; sutural stria deep, curved in front obliquely towards outer fourth of basal elytral margin and connected with lateral stria; elytral punctation in basal half dense and decidedly



Figs. 7-12, Aedoeagi, dorsal and lateral view: 7 and 8, *S. flagellata* n. sp., paratype from East Turkey Crk.; 9 and 10, *S. valida* n. sp., paratype from Wet Cn.; 11 and 12, *S. irregularis* (Champ.), from Ash Cn.

coarse, here and there (not laterally) coarse punctures extend beyond middle, punctation of apical half otherwise very fine. (In holotype punctation of apical half of elytra appears distinctly sparser, finer, and more irregular than in specimens from Arizona). Mesepimera slightly more than twice as long as distance between them and mesocoxae. Middle portion of metasternum slightly (holotype) or barely elevated, without impressions; narrow oblong middle portion smooth, rest of surface coarsely and closely punctate. (In holotype smooth middle portion of metasternum wider, punctation of surface finer and sparser than in specimens from Arizona); metasternal margin between metacoxae slightly concave (holotype) or straight; punctation of lateral portions of metasternum extremely fine and very sparse. Metepisterna rather narrow, convex and smooth, not (holotype) or only slightly convergent proximally and rounded apically; inner metepisternal suture deeply impressed, punctate. First sternite with a basal row of punctures which is widely interrupted medially and extends laterally to level of inner margin of metepimera; surface without microsculpture, punctation extremely fine and sparse. Tibiae slender and straight; mesotibiae 0.55-0.58 mm, metatibiae 0.68-0.72 mm long. Metatarsi 0.56-0.62 mm long. *Male*: Segments 1-3 of protarsi and segments 1-2 of mesotarsi strongly enlarged; apical margin of sixth sternite as in Fig. 6; aedoeagus as in Figs. 11 and 12, strongly sclerotized, 0.92 mm long. *Length* 2.0-2.15 mm.

Material examined. Holotype (female) labelled "Omilteme, Guerrero. 8000 ft. Aug. H.H.Smith"/"1911-403"/"Type" (red)/"Baeocera irregularis Ch." (in handwriting)/"Tr.Ent.Soc.L.1913. det. Champion". *Arizona*: Huachuca Mts., Ash Cn., 5000′, 2-VIII-69, 1 male and 2 females; Santa Rita Mts., Madera Cn., 5500′, 3-VIII-69, 1 female (CNC, MG).

Bionomics. Specimens from Arizona were collected by sifting more or less moist layers of fallen leaves in a dry creek bed, and along a small running creek in the deciduous forest.

Discussion. *S. irregularis* was known previously only from the single original specimen from Mexico. As there are some differences between the holotype and the specimens from Arizona, and as the holotype is a female, the association of Arizonan specimens with this name is tentative pending study of additional males from Mexico.

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EDITORIAL

In the new schedule of prices from our printer, it is obvious that *tabular* matter is expensive. Henceforth, all tabular matter in excess of 1/3 of a printed page will be treated as camera-ready copy for an illustration. Therefore: authors will be required to submit such copy in single space (or however they want it to appear), and *NO* corrections will be allowed in galley unless the cost of the illustration is paid in full.

Generally, we have had approximately half of our costs met through page charges, the balance coming from subscriptions. My first issue may signal an unfortunate change, in that less than 30% was paid, and continuance in this direction could lead rapidly to economic ruin. Why not raise dues? or institutional page charges?—both of which are the usual cop-outs? Well, both may prove necessary, but let's try to delay them: *increased dues* may result in reduction of our subscription base; and *increased page charges* would probably backfire because institutions are already looking for alternatives to counter exorbitant publication costs. My suggestion is that *individuals* be offered an opportunity to contribute toward partial publication costs, on an optional basis (and we have had private indications of willingness to do so). I suggest that $5.00/page would be very helpful to us, and should help delay the unwanted spectres of increased subscription/institutional page charges. Future billings will reflect this suggestion. If response is adequate, we will continue to develop the Society and expand the Bulletin.

We do want to expand the Bulletin, and hence to expand its base. One possible area still unexplored is economic entomology. I *do not* mean papers associated with control procedures; I *do* mean contributions principally concerned with beetle biology (which, after all, is our function). We should encourage all such articles. Why? Most will be funded—and page charges met.

In this issue, I call particular attention to articles by Ryker, Glaser, Clark, and Balsbaugh: this is the general type of material I should like to see in the Bulletin—a data base developed to include interesting and novel observation. Note also the treatment of tabular material in Ryker's paper—this will be the general appearance of photographic treatment from camera-ready copy. Also in this issue, I have started to make the promised change in type-style, giving preference to those articles with general interest material. Changeover in style will continue to evolve in future issues.

—D. R. Whitehead

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LECTOTYPE DESIGNATIONS AND REMARKS ON SOME SPHAERIDIINAE FROM THE SHARP COLLECTION (COLEOPTERA: HYDROPHILIDAE)

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Abstract

The type material of *Phaenonotum laevicolle* Sharp 1882, *Pelosoma sordidum* Sharp 1882, and *Pelosoma lafertei* Mulsant 1844 was studied. Lectotypes are designated for *Phaenonotum laevicolle* and *Pelosoma sordidum*, and remarks on all 3 species are presented.

Recently, I studied the original material of some South and Central American Sphaeridiinae. None of these species was known to occur north of Mexico, but I needed to compare them with some species included in my revision of Sphaeridiinae of America north of Mexico. The results of this study, mainly lectotype designations, are presented here.

The original specimens from the Sharp collection were made available to me by Mr. P. M. Hammond, British Museum (Natural History), London. His assistance is gratefully acknowledged.

Phaenonotum laevicolle Sharp

Phaenonotum laevicolle Sharp 1882, Biol. Centr.-Amer. I, 2: 99

The original series of this species in the Sharp Collection, British Museum (Natural History), London, consists of 10 specimens. I examined 4 syntypes from this series. They are labelled as follows: *Spec. No. 1*: [male sign]/"Type H.T.". (round label with red margins)/"Phaenonotum laevicolle Type D.S. Cordova. Mex. Sallé."/"Sharp Coll. 1905.-313."/"B.C.A. I. 2. Phaenonotum laevicolle, Sharp." *Spec. No. 2*: [male sign]/"Cubiliguitz, Vera Paz. Champion."/"B.C.A. Col. I. 2 Phaenonotum laevicolle, Sharp." *Spec. No. 3*: "Phaenonotum laevicolle D.S. Zapote. Guatemala. Champion" (on plate with beetle)/"Sharp Coll. 1905.-313."/"Zapote, Guatemala. Champion."/"B.C.A. I. 2. Phaenonotum laevicolle, Sharp." *Spec. No. 4*: "Phaenonotum laevicolle D.S. Vera Cruz. Mex. Sallé" (on plate with beetle)/"Mexico Salle Coll."/"Veracruz September"/"Cyclonotum extriatum Say = minutum Cast. apud Sallé."

Specimen No. 3, from Zapote, is slightly different from the others and does probably not belong to the original series (locality not given by Sharp 1882: 99).

The first male specimen bearing the round label "Type H.T." with red margins (the aedoeagus, left front leg, and abdomen are mounted separately on the plate with the beetle) is hereby designated as lectotype of *Ph. laevicolle*; the label "Lectotype Phaenonotum laevicolle Sharp Smetana des. 1974" was attached to this specimen.

Ph. laevicolle can rather easily be distinguished from the North American *Ph. exstriatum* (Say) by the different shape of the male copulatory organ, finer and distinctly sparser pronotal punctation, and, in most specimens, by the more sparsely and coarsely punctate elytra.

Pelosoma sordidum Sharp

Pelosoma sordidum Sharp 1882, Biol. Centr.-Amer. I: 2: 99

The original series of this species in the Sharp Collection, British Museum (Natural History), London, consists of 31 specimens. I examined 13 syntypes from this series. They are labelled as follows: *Spec. No. 1*: "Pelosoma sordidum. Type D.S. Cerro Zunil, 4000 ft. Guatemala. Champion" (on plate with beetle)/"Type" (round label with red margin)/"Cerro Zunil, Guatemala, Champion."/"Sharp Coll. 1905.-313."/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp." *Spec. No. 2 and 3* (on one plate, spec. No. 3 dissected): exactly the same labels as in No. 1, except without the label "Type". *Spec. No. 4*: "Pelosoma sordidum var. D.S. S. Geronimo. Guatemala Champion". (on plate with beetle)/"Sharp Coll. 1905.-313."/"San Geronimo, Vera Paz. Champion."/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp." *Spec. No. 5-6* (on one plate): "Pelosoma sordidum var. D.S. Senahu Guatemala Champion" (on plate with beetle)/"Sharp Coll. 1905.-313."/ "Senahu, Vera Paz. Champion."/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp." *Spec. No. 7-8* (on one plate): "Zapote, Guatemala, G.C. Champion."/"B.C.A. I. 2. Pelosoma sordidum, Sharp." *Spec. No. 9*: "Tamahu, Vera Paz. Champion."/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp." *Spec. No. 10*: "Bugaba, 800-1,500 ft. Champion."/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp."/"Pelosoma sordidum var." (handwritten). *Spec. No. 11:* "Teapa"/"Mexico. Salle Coll."/"934"/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp." *Spec. No. 12*: "Mai"/"Cordova Mexico. Salle Coll."/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp."/"Pelosoma sordidum" (handwritten). *Spec. No. 13*: "Cordova"/"Mexico. Salle Coll."/"B.C.A. Col. I. 2. Pelosoma sordidum, Sharp."/"Pelosoma sordidum" (handwritten).

All specimens are conspecific, but specimens Nos. 8, 10, and 11 are very small.

Specimen No. 1 (with the "Type" label) is hereby designated as lectotype of *sordidum*; the label "Lectotype Pelosoma sordidum Shp. Smetana des. 1975" was attached to this specimen.

The genus *Pelosoma* is very widely distributed in the Neotropical Region and is also very rich in species, most of them undescribed; the similarities and relationships of these species can be determined only after a detailed revision of the whole genus.

Pelosoma lafertei Muls.

Pelosoma lafertei Mulsant 1844, Palp.: 185

Pelosoma lafertei; Sharp 1882, Biol. Centr.-Amer. I, 2: 109

This species was described by Mulsant (1844: 185) from a single specimen that he believed to have been taken in Europe (France). However, Sharp (1882: 109), who possessed Mulsant's holotype from the Laferté Collection, expressed the opinion that the species was actually Neotropical; the Mulsant holotype agreed, except for some "very minute and unimportant details", with his South American specimens (see Sharp, l.c., for more details). This opinion was generally accepted (e.g. Ganglbauer 1904: 284). A few specimens of this species were later recorded from Europe (as introduced) from a few spots around the Mediterranean Sea (Chiesa 1959: 111); the species is otherwise very widely distributed in South and Central America, and seems to be common.

I examined the Mulsant holotype, Sharp Collection, British Museum (Natural History), London. It is labelled as follows: "Pelosoma lafertei Type ex coll. Laferté. Chinon.?-Gallia" (on plate with beetle)/"Type" (round label with red margin)/"France"/"Sharp Coll. 1905.-313."/"B.C.A. Col. I. 2 Pelosoma lafertei, Muls."

The holotype, which was originally pinned, is in rather bad condition. I was able to find one specimen, from Brazil ("Brazil, Est. Biol. Boracea Salesopolis, SP, XII-17-26-1969 J.M. & B.A. Campbell"), which matches the Mulsant holotype in every possible detail. The red label "Pelosoma lafertei Muls., compared with holotype, Smetana 1975" is attached to this specimen, which is deposited in the Canadian National Collection, Ottawa.

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GANGLBAUER, L. 1904. Die Käfer von Mitteleuropa IV. (1). Wien, 286 p.

MULSANT, E. 1844. Histoire naturelle des Coléoptères de France. Palpicornes. Paris, 7 + 196 p., 1 pl.

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departments, provinces, parishes, and/or counties listed. Dates are listed by day, month (in Roman numerals), and last 2 digits of the year. Listing of ecological data is encouraged. Location of specimens should be shown in brackets; if the data is extensive these should be abbreviated as shown and the abbreviations listed in the text.

Any article concerning Coleoptera will be considered. Descriptions of new taxa must contain keys (or be correlated with existing keys) and illustrations. All manuscripts should be typed on 8½×11" opaque white paper with 1 inch margins. They should be typed on one side only and double spaced throughout (including title, footnotes, tables, figure legends, and references). All scientific names should be underlined. Use the following order: title, author, author's address, abstract, body of text, references cited, and figures. All footnotes, tables, and figure legends should be provided on separate sheets and double spaced. Indicate approximate figure and table locations in pencil in the margin of the manuscript.

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WANTED: Carabidae *larvae.* Studying the phylogeny of the tribes Morionini, Pterostichini, Agonini, and Amarini as a thesis problem. Request loans, will sort. Contact for further information and/or send to Raymond G. Thompson, Dept. Ent., Univ. of Arkansas, Fayetteville, AR 72701. 501/575-2451.

STAPHYLINIDAE: If anyone wishes to send us unsorted Staphylinidae in 70% alcohol we will *eventually* return 1 or 2 specimens mounted, labeled and identified to the nearest possible taxon. Ecological data particularly desired. Ian Moore, Div. Biological Control, Univ. of California, Riverside, CA 92502.

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LATHRIDIIDAE: Want specimens from entire world; exchange specimens, literature, and experiences. Jurgen Otto, 4006 Erkrath Kirchstr. 36—West Germany.

PUERTO RICAN COLEOPTERA: Building reference collection; need determiners (can keep duplicates). Will also exchange. Julio Micheli, 14 Baldorioty St., Mariani, Ponce, Puerto Rico 00731.

LUCANIDAE: Buy, sell, exchange all species. Also want collection data and world literature on the family. Bill E. Gavin, 981 N. W. Circle Blvd. #1, Corvallis, OR 97330.

CARABIDAE: Have *Calosoma (Carabominus) asper* Jeannel & *C. (Blapstoma) chihuahua* Gidaspow for exchange. I want *Carabus,* Cychrini, or *Calosoma* not represented in my collection. B. Rotger, Pagosa Springs, Colo. 81147.

RHYSODIDAE: Wanted, for world-wide revision. Willing to identify and return or exchange for U. S. Carabidae. Ross T. Bell, Zoology Dept., University of Vermont, Burlington, VT 05401, U.S.A.

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THE
COLEOPTERISTS
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AN INTERNATIONAL JOURNAL DEVOTED TO
THE STUDY OF BEETLES

VOLUME 30, NO. 3 SEPTEMBER, 1976

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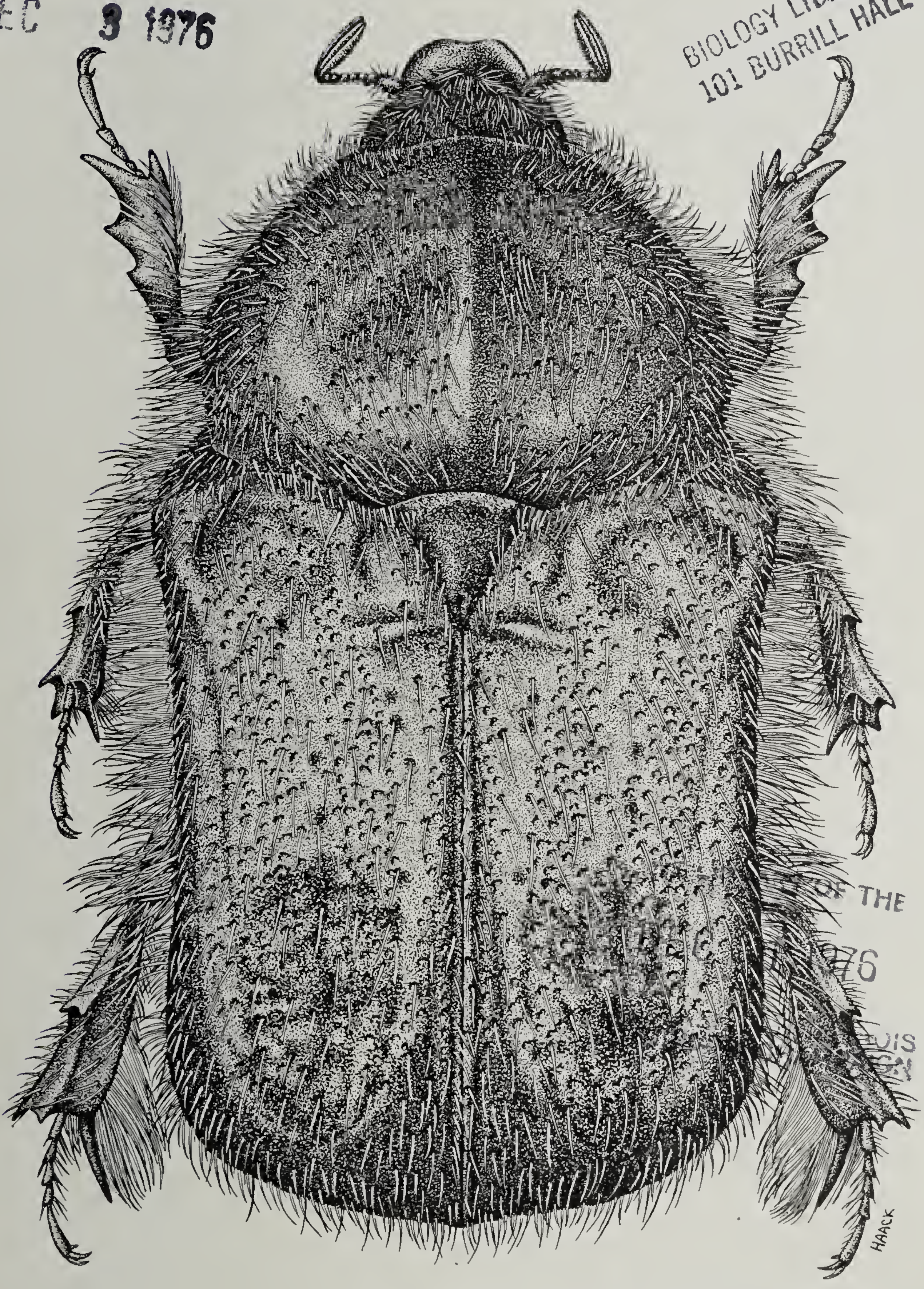

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EUPHORIASPIS HIRTIPES (Horn)

Edited By: Donald R. Whitehead

Mailing date for this issue: November 8, 1976

THE COLEOPTERISTS BULLETIN

(FOUNDED 1947 BY ROSS H. ARNETT, JR.)

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Specimen label data should be listed in the following manner: MEXICO: State of Veracruz, Fortin de las Flores, 10-VIII-70, I. B. Jones, under bark of **Pinus moctezumae**, 7000ft. [USNM] (2). The number in parentheses indicates the number of specimens. Geographical names are listed in order with largest units first, with states,

(*Continued inside back cover*)

(Mailed under second-class permit at Gainesville, Florida. Postmaster: send form 3579 to editorial office—Dr. D. R. Whitehead, c/o Department of Entomology, Stop 168, Smithsonian Institution, Washington, DC 20560).

NOTES ON THE BIOLOGY OF *EUPHORIASPIS HIRTIPES* (HORN) AND DESCRIPTIONS OF THE LARVA AND PUPA (COLEOPTERA: SCARABAEIDAE)

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Division of Entomology, University of Nebraska State Museum
University of Nebraska, Lincoln, NB 68508

ABSTRACT

Euphoriaspis hirtipes (Horn) is a myrmecophilous scarab that occurs only in portions of the prairie region of the central United States. The immature stages are passed within the thatch nests of the genus *Formica*. The eggs remain unknown, but the third instar larva and the pupa are described and illustrated.

INTRODUCTION

Euphoriaspis hirtipes (Horn) (Fig. 1) was originally described in the genus *Euphoria*, but Casey (1915) later established the monotypic genus *Euphoriaspis* for it. Blackwelder (1939) placed *Euphoria aestuosa* Horn in *Euphoriaspis* upon the recommendation of Chapin, but I do not know if this move was justified. *Euphoriaspis,* both morphologically and behaviorally, is a highly derived genus that probably arose from a *Euphoria* or *Euphoria*-like ancestor.

Prior to this study, there were very few specimens of adult *E. hirtipes* in collections with the exception of the University of Nebraska which possessed 125 examples collected in 1905. The immature stages were undescribed and very little was known of the biology of this species other than that adults could be found in some numbers in ant nests (Riley 1882; Schwarz 1889). Examples of adults collected during this study are in a number of institutional and private collections, and examples of the immature stages are in collections of the University of Nebraska, the U.S. National Museum, and the author.

Field-collected 3rd instar larvae were successfully reared in the laboratory. A sandy soil base and an upper layer of ant nest thatch material were placed in plastic shoeboxes at 27°C ± 2°; the thatch provided the organic debris needed for food, and the soil enabled construction of pupal chambers.

Other myrmecophilous Scarabaeidae were also found in the same nests with *E. hirtipes*, including *Euphoria inda* (L.) and several species of *Cremastocheilus*. Great care had to be exercised when dealing with the immature stages because of the considerable similarity in appearance between *Euphoriaspis hirtipes* and *Euphoria inda*. The descriptive treatment of the larvae to follow will differentiate the 2 species.

BIOLOGY

Euphoriaspis hirtipes is a myrmecophilous scarab that occurs only in portions of the prairie region of the central United States. It has adapted well to an environment of sandy grasslands which are usually hot and dry during the summer and very cold during the winter. Adults are nearly always found within the large thatch nests (Fig. 2) of red ants of the genus *Formica*. The basic form of such a nest is a central, rounded pile of thatch from several centimeters to one meter deep and from several centimeters to 1.5 meters across, depending on the age of the nest. The thatch pile may rise 5-25 cm above the surface of the ground. The thatch consists of seeds, small twigs, bits and pieces of grass stems and other plants, and some soil. The

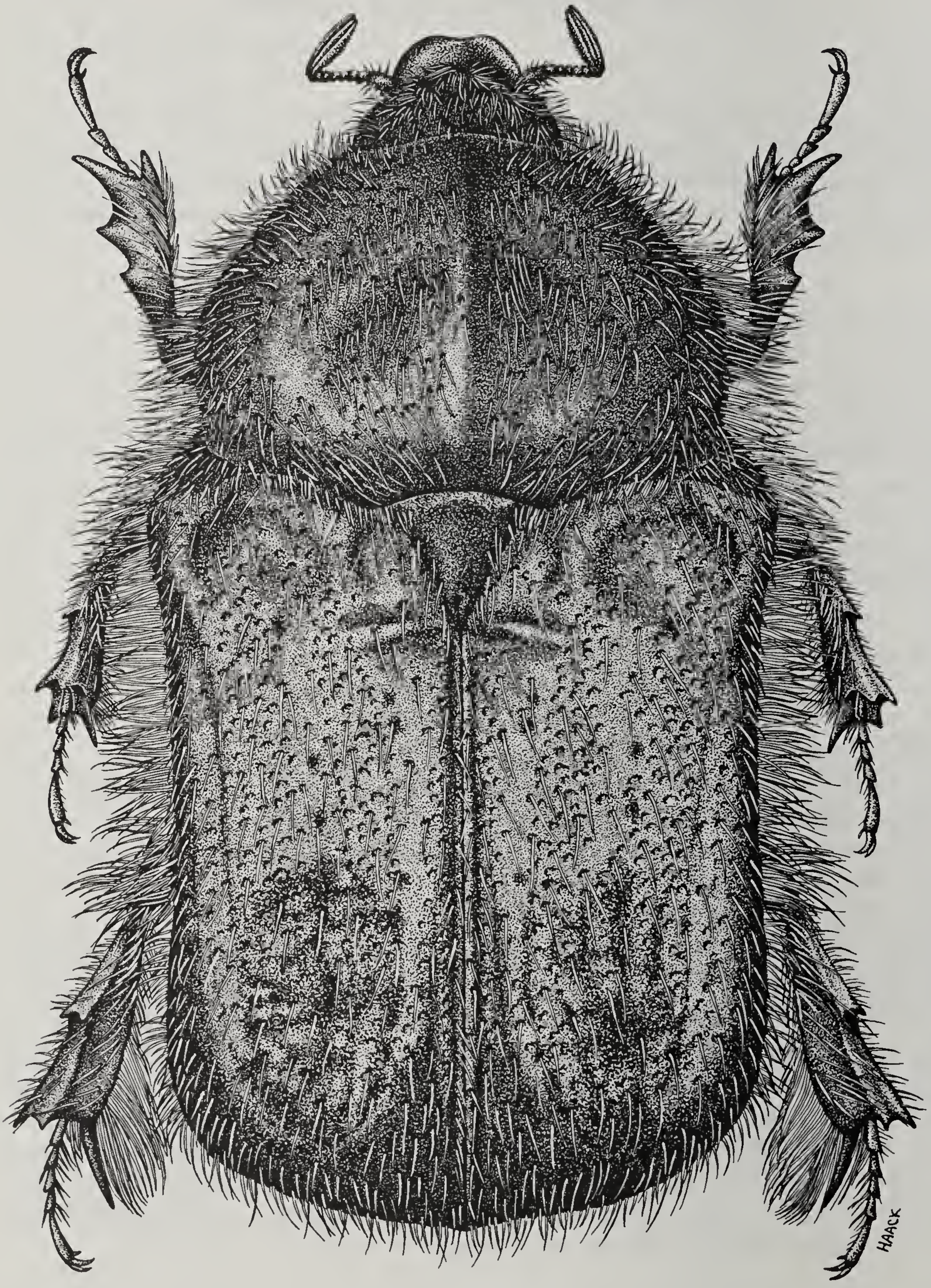

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Fig. 1. Habitus view of adult male *Euphoriaspis hirtipes* (Horn).

ground immediately surrounding the thatch pile is variably honeycombed with ant tunnels, and it is in this region of soil-thatch interface that the larvae and pupae of *E. hirtipes* are most commonly found. Adult beetles are usually scattered randomly throughout the thatch portion of the nest, but most are in the upper 5-25 cm of soil-thatch interface.

Except for one adult taken in flight, all adult beetles were taken in the thatch nests of *Formica* species (*Formica obscuripes* Forel, *F.* near *dakotensis* Emery, and *F.* near *haemorrhoidalis* Emery). I suspect that the beetles can be found with any of the various ant species that construct thatch nests. I have taken as many as 60 larvae and 85 adults from a single nest.

Overwintering adults were found only through early May. Temperatures in the western 2/3 of Nebraska are still cool up until this time, and the adult beetles probably remain clustered within the ant nests to mate and oviposit. The adults seem to leave the nests after the eggs are deposited; I have never found them or their remains in nests during the late spring or summer.

The commensal relationship, if any, between *E. hirtipes* and the ant hosts is uncertain. Clearly, all stages in the life cycle of the beetle are provided some degree of protection, shelter, or food by the ants and their nest, but it remains to be seen what advantage the ants gain from their guests. I *have* seen ants clinging to the humeral region of adult beetles, and this might indicate that the ants are licking some sort of aromatic secretion which is diffused from trichomes on the beetle. Although possible synoecy exists, the beetles are probably treated as symphiles most of the time. Gut analyses by myself and Paul Lago (per. comm.) of adult beetles were negative and so the question remains as to whether adult beetles feed.

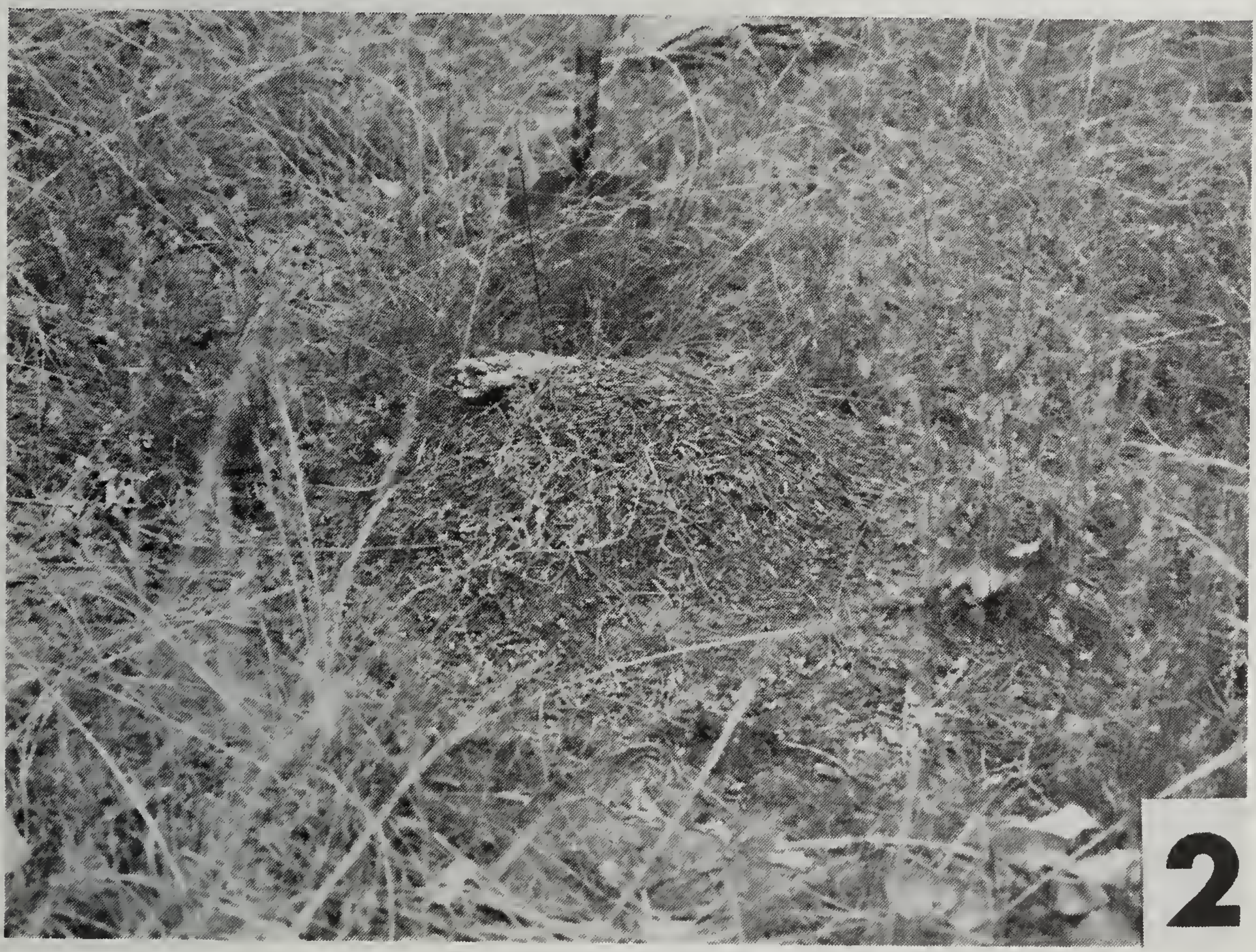


Fig. 2. Thatch nest of *Formica* sp.

I have not found the eggs of *E. hirtipes* but believe that they are randomly scattered in the thatch nest material, thus making them extremely difficult to detect. Because larvae have never been seen within a nest during April, I assume the larvae hatch in early May; they then proceed to develop near the periphery of the thatch where they feed on an abundance of decaying organic material. I do not know the exact lengths of each of the 3 instars, but I have taken 2nd and possibly 1st instar larvae from the same nest on May 30. If eggs are deposited from late April until the first 1-2 weeks in May, this would indicate an approximate length of 2-5 weeks for the 1st stage larvae. The 2nd larval stage probably lasts about 3-4 weeks (the month of June), as I have taken well-developed 3rd instar larvae on July 10. Laboratory rearing and field sampling suggest that the 3rd larval stage lasts about 6 weeks (early July to late August).

The larvae are not dependent on their ant hosts for food, *per se*, as an inadvertent experiment demonstrated. At the University of Nebraska's Sandhills Agricultural Laboratory, all the adult *E. hirtipes* were collected from a nest site in early May; the nest was damaged to such an extent that the ants moved and established a new nest 2 meters away. Resampling of the abandoned nest area in mid-July, however, yielded numerous 3rd instar larvae of *E. hirtipes*. Apparently the eggs had been overlooked during the May sampling, and the larvae had hatched and continued to develop and feed on the remaining organic debris in the sandy soil of the abandoned nest; the ants themselves did not actively provide the larvae with food. Had these larvae been left undisturbed they would have probably completed a normal development, the adults then seeking new nests in which to oviposit.

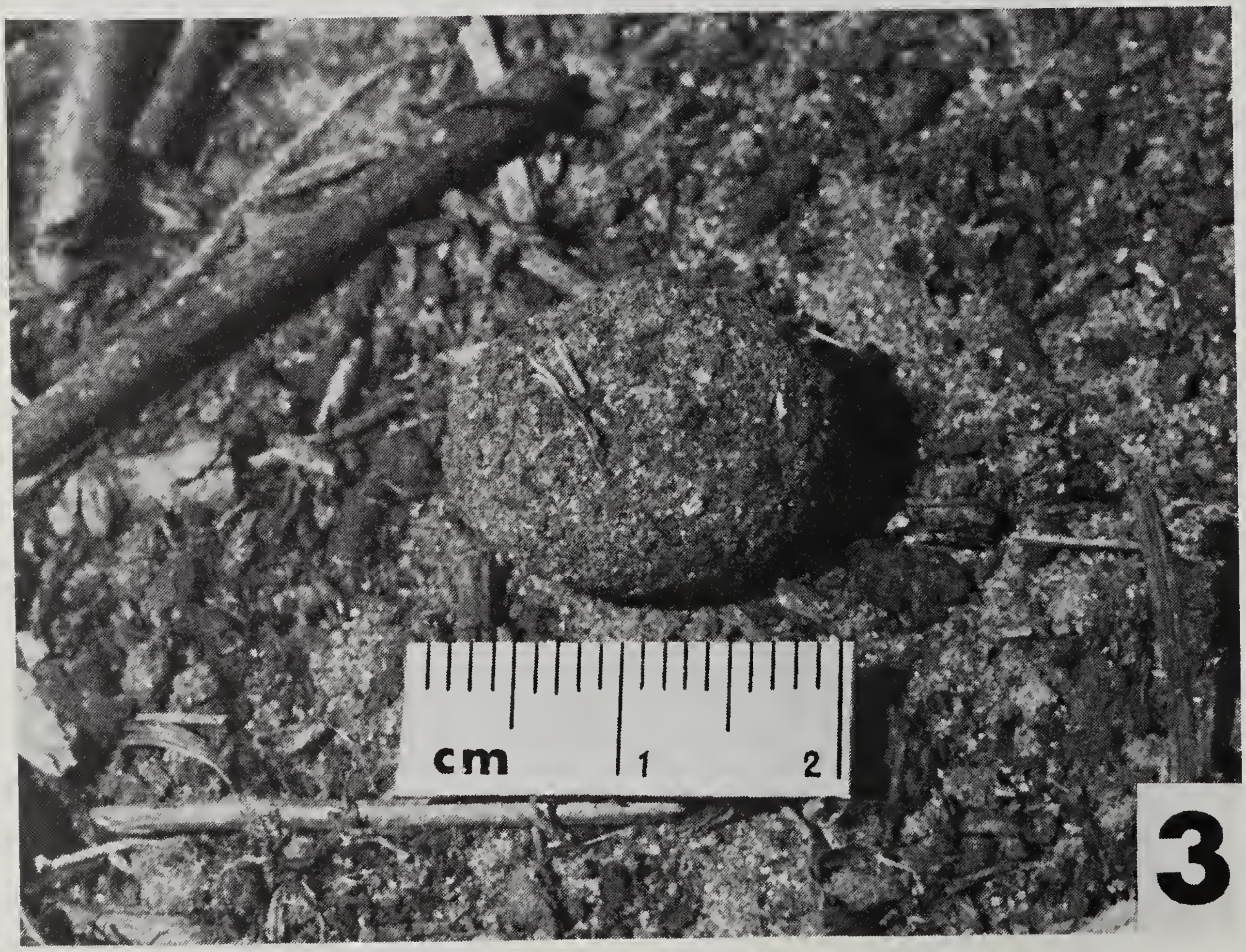


Fig. 3. Pupal cell of *E. hirtipes*.

Laboratory rearing and field sampling indicated that pupation occurs in late August and lasts approximately 10-20 days. An oval, earthen pupal cell (Fig. 3) is formed by the larva prior to pupation, normally 10-25 cm below the surface in the soil adjacent to the central core of thatch material. The winter is then passed by the adult within the ant nest.

DISTRIBUTION

Euphoriaspis hirtipes is found primarily in the following grassland communities: Nebraska sandhills prairie (*Andropogon-Calamovilfa*); grama-buffalograss (*Bouteloua-Buchloe*); bluestem prairie (*Andropogon-Panicum-Sorghastrum*); wheatgrass-bluestem-needlegrass (*Agropyron-Andropogon-Stipa*); wheatgrass-needlegrass (*Agropyron-Stipa*); and probably bluestem-grama prairie (*Andropogon-Bouteloua*). It is apparently restricted to these prairie areas in Nebraska, eastern Colorado, North Dakota, and possibly a large portion of Kansas and South Dakota. Additional collecting is needed to determine whether the species occurs in Wyoming. Fig. 4 illustrates the collecting records and possible range of *E. hirtipes* based on the ranges of the previously mentioned grassland associations. Searches of the collections at the University of Kansas, the University of Colorado, and the U. S. National Museum did not reveal any additional distributional data, and so the specimens from Nebraska and North Dakota and the larvae from Colorado seem to constitute the only known records. This species is relatively widespread in Nebraska but is most common in the more arid sandhills region in the western part of the state.

Locality Records (Fig. 4).—321 specimens examined (210 adults, 8 pupae, 103 larvae). COLORADO (8): *El Paso:* Colorado Springs. NEBRASKA (313): *Cuming:* West Point; *Custer:* Berwyn; *Dodge* (Horn 1879): Glencoe (10 mi. W. Scribner) (Schwarz 1889); *Garden:* Ash Hollow State Historical Park; *McPherson:* Univ. Nebr. Sandhills Agr. Lab.; *Sheridan:* no data; *Thomas:* Nebraska National Forest. NORTH DAKOTA (Lago, pers. comm.): *Grant; Kidder; Morton; Stutsman.*

THIRD STAGE LARVA
(Figs. 5-8)

Maximum width of head capsule (Fig. 5) 3.80 mm; surface of head irregularly reticulate, testaceous. Frons with median, shallow, longitudinal depression; depression forked anteriorly, extending forward from epicranial suture; frons with anterior frontal seta, posterior frontal seta, exterior frontal seta, and anterior angle seta on each side. Dorsoepicranial setae 1-2 large and 5-10 small setae on each side, usually in irregular, oblique line diverging from center-base of head. Labrum trilobed, clithra present. Epipharynx (Fig. 6) without plegmata; haptomeral region with irregular, transverse, curved row of short heli. Left mandible (Fig. 7) with 2 scissorial teeth anterior to scissorial notch and 2 scissorial teeth posterior to same notch. Maxilla (Fig. 8) with galea and lacinia fused, forming mala; mala with 3 unci at apex, unci of lacinia fused at bases. Antennae with 2 dorsal sensory spots on last segment.

Spiracles reniform. Thoracic spiracle with posterior emargination in respiratory plate; each abdominal spiracle with anterior emargination in respiratory plate. Thoracic spiracle 0.35-0.50 mm long and 0.25-0.35 mm wide. Abdominal spiracles about same size as thoracic spiracle.

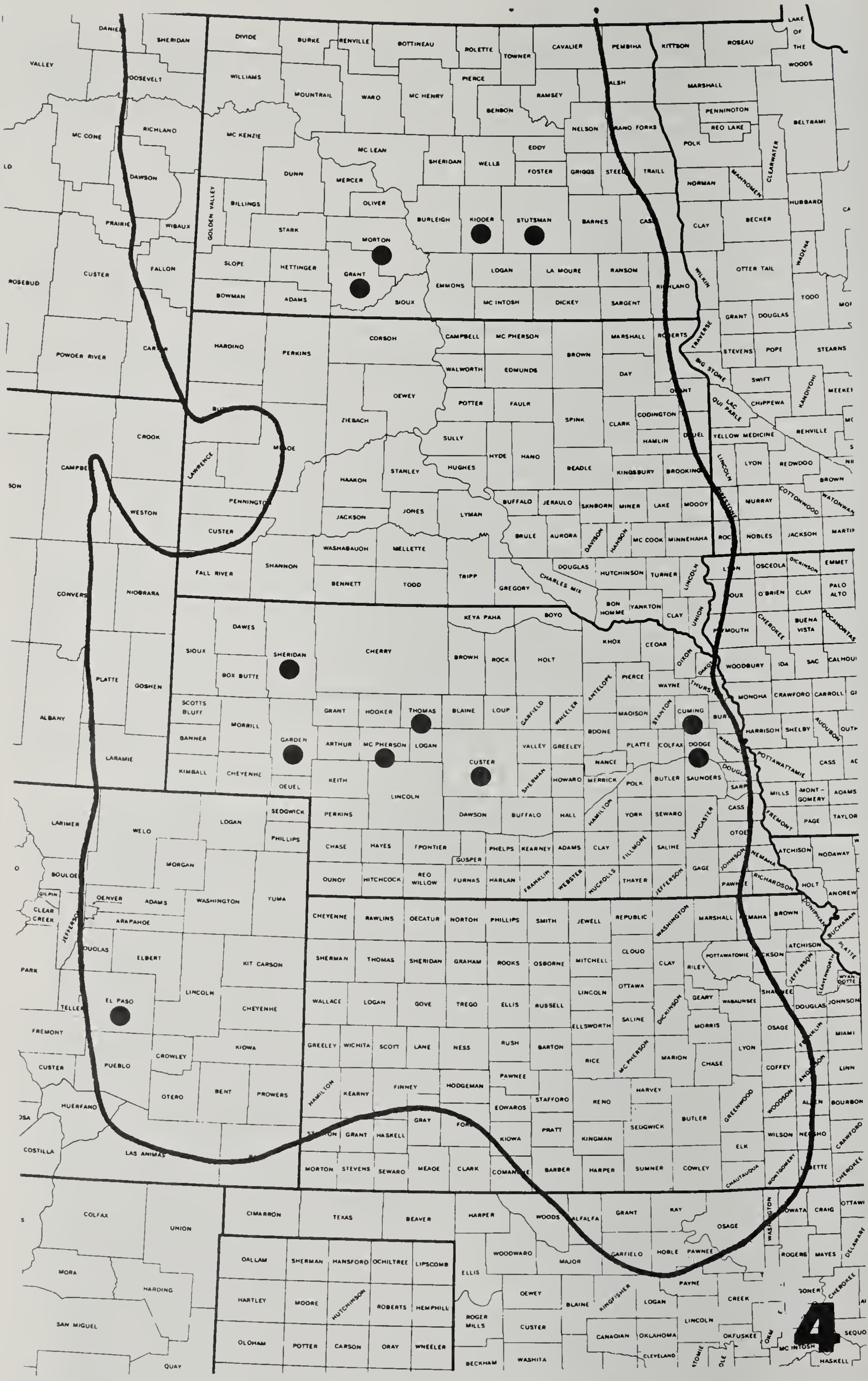
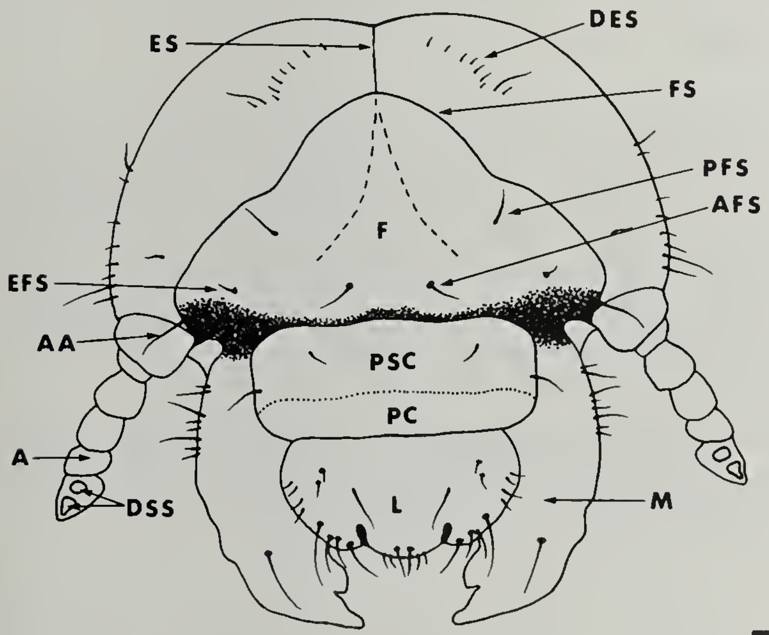


Fig. 4. Distribution of *E. hirtipes*. Dots indicate collecting records, solid line indicates estimated total possible range for the species. See text.

Dorsa of abdominal segments 7 and 8 each with 2 sparse, transverse bands of setae, each band with 2-3 sparse, irregular rows of short, stout setae and a few long setae; each posterior row with several very long setae. Dorsa of abdominal segments 9 and 10 fused. Spiracular areas of abdominal segments 1-8 each with 15-27 setae. Pleural lobes of same segments with several short setae and usually 14-25 long setae. Venter of abdominal segments 1-8 each with long, irregular, transverse row of setae, each row with 23-32 very long setae and some smaller setae. Pedal area of same segments with 5-9 short setae and 3-4 long setae. Raster without pallidia. Teges with numerous posteriorly directed short setae and with several very long setae interspersed laterally. Lower anal lip with numerous short setae as on



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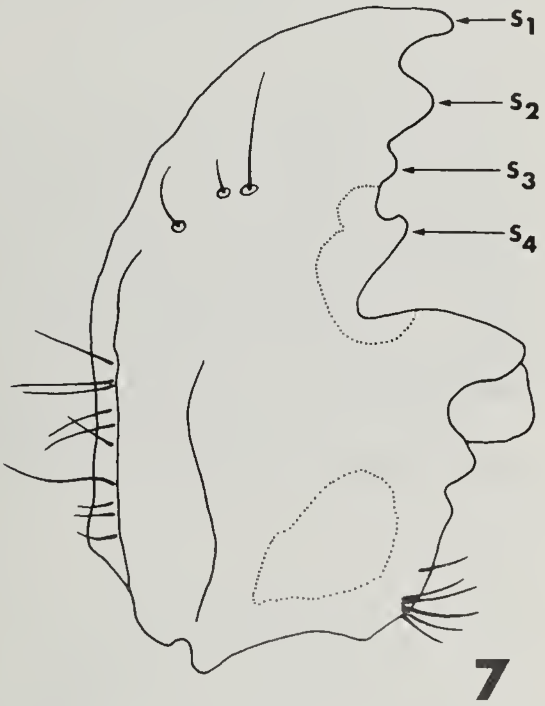

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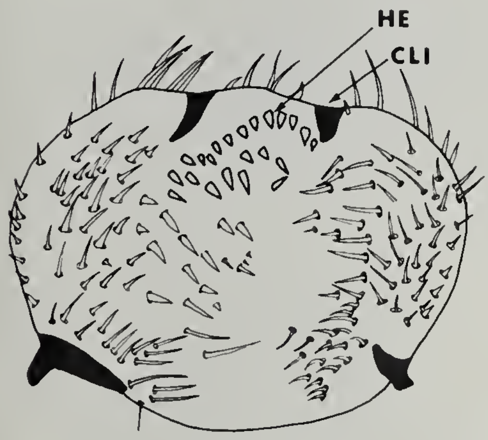

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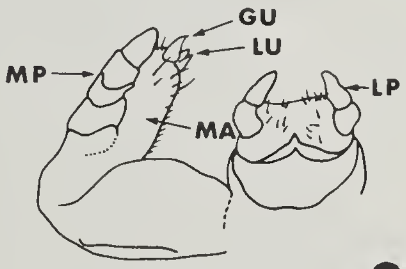

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Fig. 5. Frontal view of head of 3rd stage larva. A, antennae; AA, setae of exterior angle of frons; AFS, anterior frontal setae; DES, dorsoepicranial setae; DSS, dorsal sensory spots; EFS, exterior frontal setae; ES, epicranial suture; F, frons; FS, frontal suture; L, labrum; M, mandible; PC, preclypeus; PFS, posterior frontal setae; PSC, postclypeus.

Fig. 6. Epipharynx of 3rd stage larva. CLI, clithrum; HE, heli.

Fig. 7. Dorsal aspect of left mandible of 3rd stage larva. S_{1-49}, scissorial teeth.

Fig. 8. Ventral aspect of left mala and hypopharynx of 3rd stage larva. GU, unci of galea; LP, labial palp; LU, unci of lacinia; MA, mala; MP, maxillary palp.

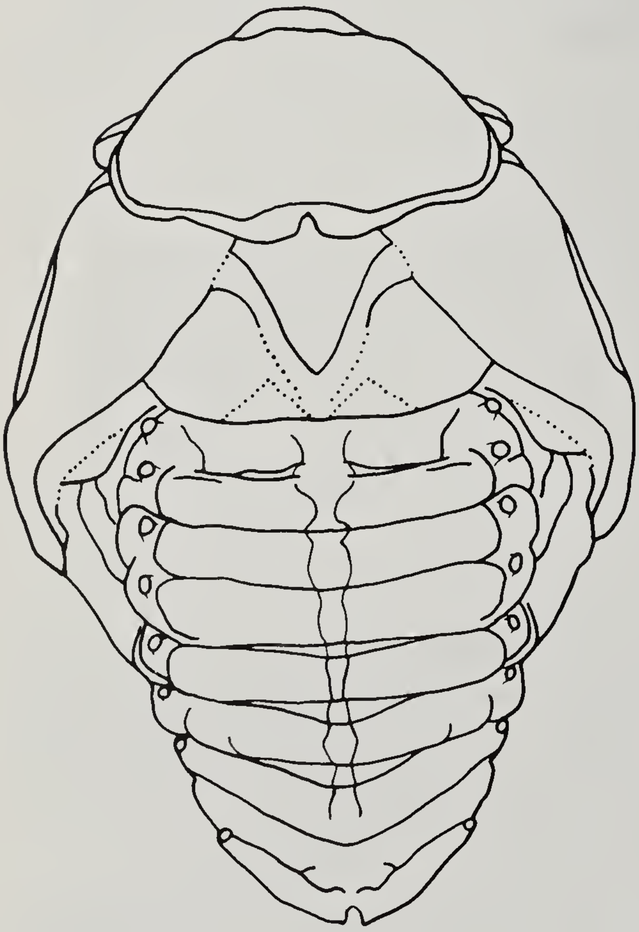
teges and with 24-40 long setae; 2-3 very irregular, transverse rows of short setae adjacent to anal slit. Claws on legs cylindrical, each with about 10 setae.

Diagnosis.—*Euphoriaspis hirtipes* may be easily distinguished from the closely related *Euphoria inda* by the following characteristics: Frons in *E. hirtipes* with 8 setae, 4 in *E. inda* (see Ritcher 1945, 1966). Dorsoepicranial setae 6-12 in *E. hirtipes*, 4-6 in *E. inda*. Spiracular area of *E. hirtipes* with 15-27 setae, only 9-13 in *E. inda*. Pleural lobes of *E. hirtipes* with 14-25 long setae, only 12-15 in *E. inda*. Venter of each abdominal segment in *E. hirtipes* with 23-32 long setae, only 14-25 in *E. inda*. Pedal area of *E. hirtipes* with 5-9 short setae and 3-4 long setae, 1-3 short setae and 1-3 long setae in *E. inda*.

PUPA
(Figs. 9-10)

Length 13.8-15.8 mm. Shape elongate, oval, stout, exarate. Color cream white to light yellow-brown; color darkens to dark brown as eclosion approaches. Head ovate, glabrous, bent sharply beneath thorax, mouthparts directed posteriorly. Eyes, antennae, mandibles, and palps clearly discernible. Pronotum orbicular, transverse, widest at base, glabrous. Scutellum of mesothorax large, triangular, partially covering metathorax. Elytra closely appressed and curving ventrally around body, extending posteriorly to 5th abdominal segment.

Fore- and mesofemora extend at approximately 90° from longitudinal axis of body; metafemora sub-perpendicular to longitudinal axis of body.



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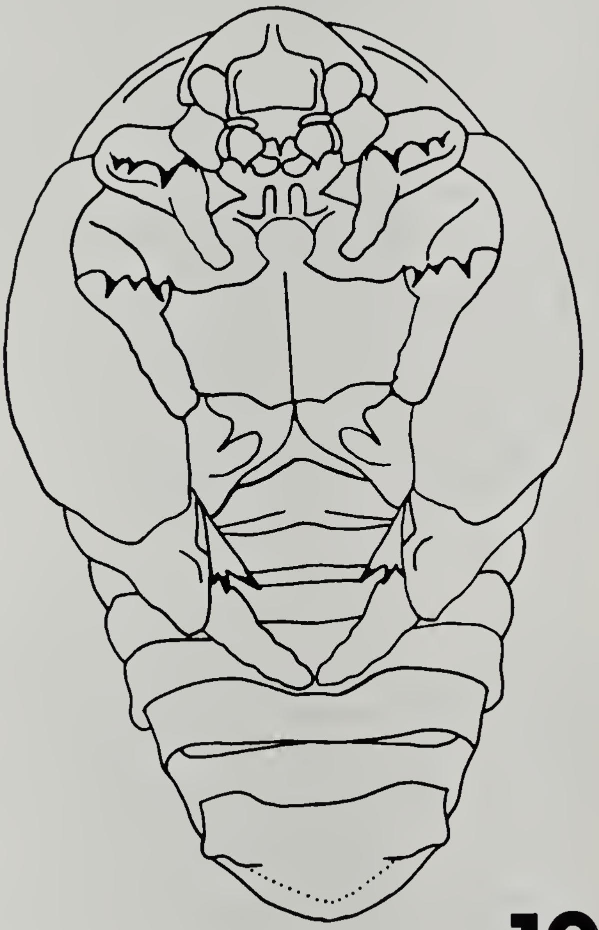

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Fig. 9. Dorsal aspect of pupa.

Fig. 10. Ventral aspect of pupa.

Darkly sclerotized apical spines of all tibiae distinct. Legs without setae. Abdomen with 9 movable, glabrous segments, last segments slightly emarginate at apex.

ACKNOWLEDGMENTS

I would like to thank Paul O. Ritcher (formerly Oregon State University) for loaning me the larvae from Colorado, and A. Chang-Fu Hung (University of North Dakota) and Roy R. Snelling (Los Angeles County Museum of Natural History) for determinations of the ants observed in this study. Appreciation is also extended to Paul Lago (North Dakota State University) for the North Dakota locality data. Special thanks are due to Martha J. Haack (Scientific Illustrator, University of Nebraska State Museum) for her detailed illustration of the adult male *E. hirtipes* in Fig. 1.

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BOOK REVIEW

Experimental analysis of insect behaviour, edited by L. Barton Browne. 1974. Springer-Verlag New York, Inc., 175 Fifth Avenue, New York, NY 10010. Hardbound, 366p., $15.40.

This excellent volume is the result of a Symposium—"Experimental Analysis of Insect Behaviour," held during the 14th International Congress of Entomology at Canberra, Australia, in 1972. Among the 25 papers are several contributions from workers who, although invited, did not attend the conference. The editor is convinced that the papers provide a "great variety of approaches to the experimental analysis of insect behaviour," and this reviewer agrees. In addition to purely behavioral approaches, purely physiological and electrophysiological approaches are presented. There seems to be little question that insect behavior and neuronal topography is much more complex than generally believed just a few years ago. It is interesting to note, however, that Fabre's classic writings are referred to several times throughout the volume. About a quarter of the papers deal with behavioral aspects of insect flight and/or migration, and among the remaining are papers dealing with behavioral aspects of reproduction, feeding, orientation, and learning. Coleopterists will be pleased to know that beetles served as the subjects of research for two of the papers—(1) "Chemical influence on feeding behavior of *Leptinotarsa* beetles," by T. H. Hsiao, and (2) "Migratory behaviour of the female of the common cockchafer *Melolontha melolontha* L. and its neuroendocrine regulation," by M. M. C. Stengel. The text has been produced from camera-ready manuscript so it has a typed rather than a printed appearance. Nonetheless, the book is reasonably attractive, contains a wealth of information and references on insect ethology, and is very reasonably priced.

—Paul P. Shubeck

THE SYSTEMATIC POSITION OF *SPHALMA QUADRICOLLIS* HORN (COLEOPTERA: SALPINGIDAE: PYTHINI) AS CLARIFIED BY DISCOVERY OF ITS LARVA

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Abstract

The larva of *Sphalma quadricollis* Horn has been collected from black cottonwood logs in East-central California, and determined from reared adults. It is described and illustrated. The presence of well developed mandibular molar areas and the structure of the preanal series of asperities preclude the placement of *Sphalma* within the Melandryidae, where it has resided for some time. Salient anatomical featues of the larvae (head, legs, and urogomphal plate) and adult males (mouthparts and genitalia) indicate a close relationship between *Sphalma* and known genera of the salpingid tribe Pythini, thus *Sphalma* is returned to the Salpingidae (Pythini).

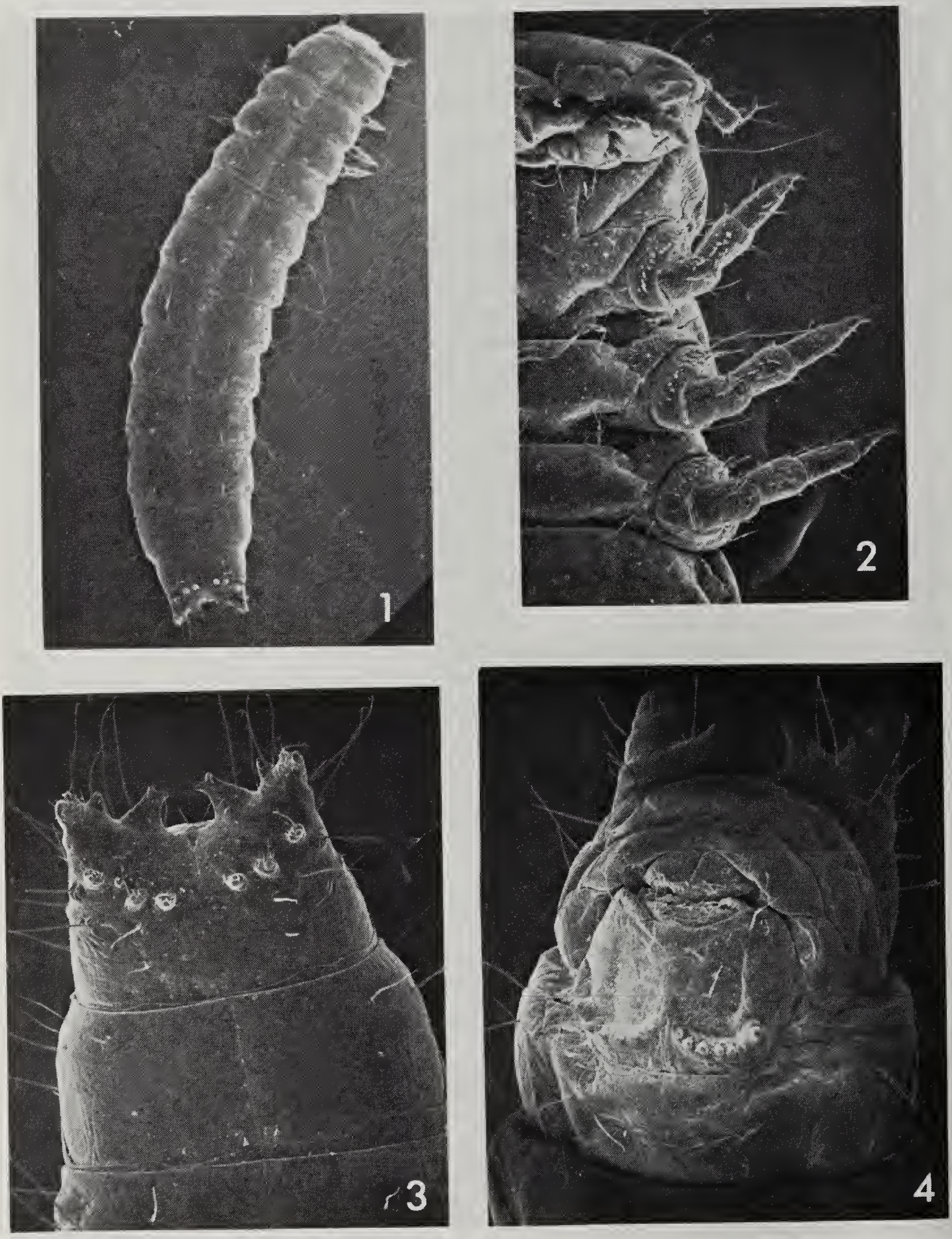
Larvae of *Sphalma quadricollis* Horn were collected in the Sierra National Forest in Mariposa County, California at 5000 ft., 11-15 June 1973. They were taken beneath the somewhat loose bark of black cottonwood (*Populus trichocarpa* Torr. & Gray) logs which were scattered along the banks of a stream. All specimens were located on the undersides of the logs, adjacent to the soil.

Several larvae were placed in a covered plastic petri dish with small amounts of decayed wood, frass, and soil, and kept at outside temperatures. Pupation ensued within a short time and thus the larvae were determined from reared adults. Several additional adults were taken by sweeping in the grassy meadow surrounding the stream. Confirmation of the determination was made by comparing reared and collected adults with an adult male which was made available by John Lawrence of the Museum of Comparative Zoology.

Description of Larva

Mature larvae (Fig. 1) attain lengths of 8.5-9 mm and widths of 1.5-2 mm. Body orthosomatic and subcylindrical, its sides subparallel. Head and body nearly white to light creamy yellow, darker in areas of heavy sclerotization such as mandibles and urogomphal calli; relative lengths (along the meson) of head (from apex of labrum to occiput) to thorax to abdomen approximately 1:3:12. Vestiture sparse, consisting of elongate setae dorsolaterally with shorter setae dorsally and ventrally; tergites of thorax and abdomen with transverse lines or *parabasal ridges* (Young 1975: 9).

Head prognathous, depressed and exserted from prothorax. Epicranial suture lyre-shaped with stem short and indistinct or absent, frontal arms complete to antennal insertions; endocarina absent. Antero-lateral aspects of head apparently with 4-5 ocelli on each side, difficult to distinguish due to lack of pigmentation in preserved specimens; rim of occipital foramen slightly reinforced. Antennae prominent, 3-segmented, 2nd segment bearing small supplementary process or sensory appendix; antennae 0.4-0.5X as long as width of head between antennal insertions, relative lengths of antennal segments 5:9:4; sensory appendix 0.2X as long as 3rd segment. Mouthparts retracted with strong, nearly symmetrical mandibles; surfaces of molar regions finely, transversely ridged, mola of right mandible slightly more prominent than that of left; apices of mandibles with 2-3



Figs. 1-4, Larva of *Sphalma quadricollis* Horn: 1, habitus (dorsal view); 2, legs (ventral view); 3, abdominal tergites 8 & 9 (dorsal view); 4, abdominal segments 8-10 (ventral view).

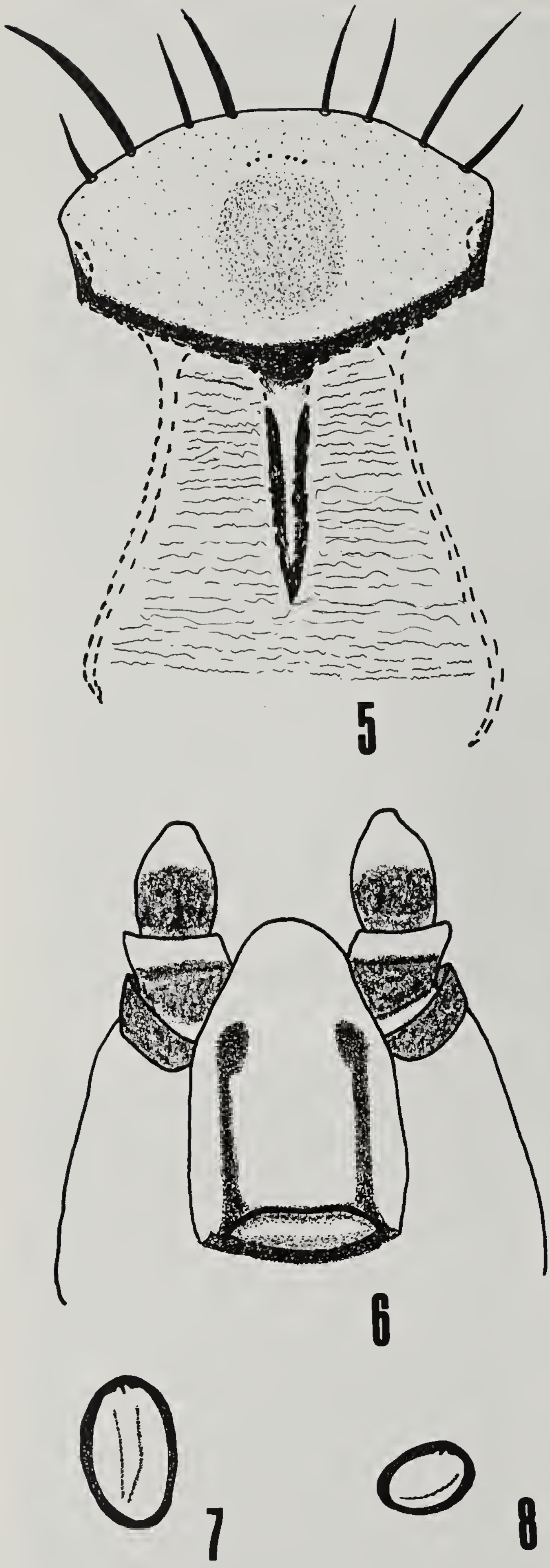
partially interlocking teeth. Labrum symmetrical, located anterad of fused frons and clypeus. Maxillae movable, composed of: 1-segmented cardo, diagonally folded upward toward stipes thus appearing 2-segmented; lightly sclerotized, undivided pad-like maxillary articulating area; maxillary mala; and 3-segmented palpus. Mala shallowly cleft at apex, bearing many stout setae along inner and apical margins as well as 3 heavily sclerotized teeth on inner apical aspect. Labium with ligula short, broadly rounded at apex; palpi 2-segmented. Width of mentum subequal to its length, broadest distally with apical margin shallowly emarginate; submentum trapezoidal, widest proximally; gula transverse, weakly sclerotized. A pair of short ventral epicranial ridges arise laterad of hypostomal margins; hypostomal rods absent. Epipharyngeal form and structure as in Fig. 5; hypopharyngeal sclerome (Fig. 6) well sclerotized with elongate anterior arms.

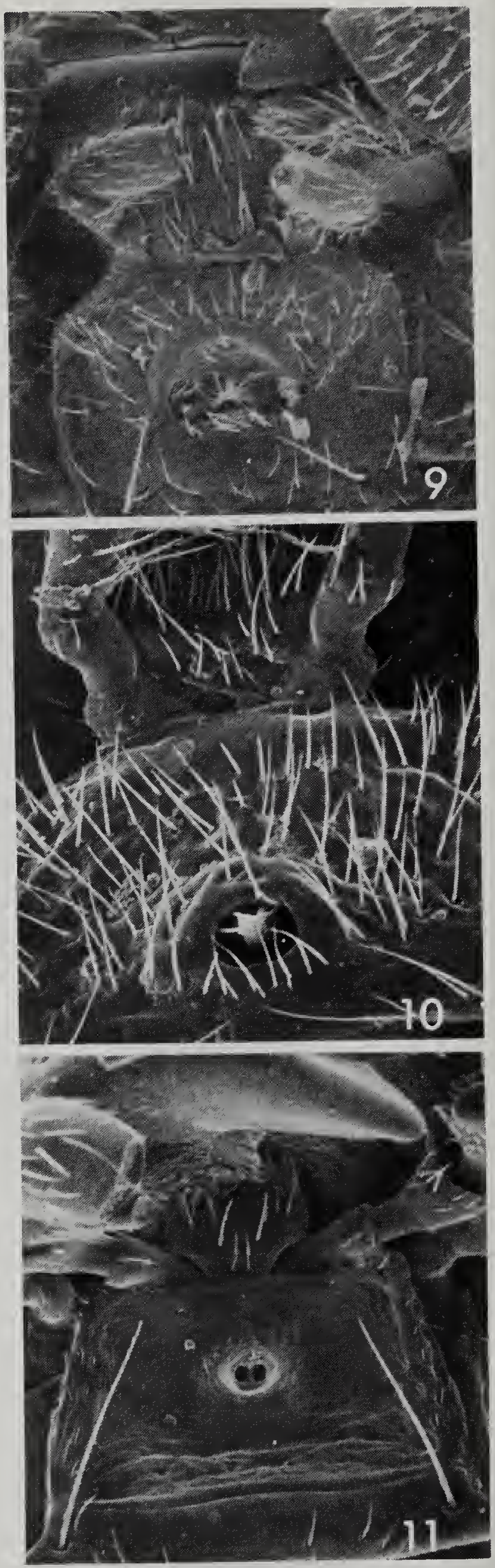
Thorax with *cervicosternum* (Watt 1970) divided into 3 parts; legs well developed, 0.5X as long as width of mesothorax, consisting of coxa, trochanter, femur, tibia, and terminal tarsungulus, with stout spine-like setae (Fig. 2) on inner surfaces; intercoxal distances (measured relative to coxal diameter) 1.5 diameters (prothorax) and 2-3 diameters (meso- and metathorax). Thoracic spiracle (Fig. 7) situated in laterotergite and bearing inconspicuous biforous openings.

Abdomen depressed to subcylindrical, moderately sclerotized, tergites 1-8 and 9 (excluding urogomphi) subequal in length. Reduced 10th segment located ventrally, laterad and postered of anus; visible as lightly sclerotized area. Annular-biforous spiracles (Fig. 8) of similar size present on anterior margins of laterotergites 1-8. Ninth tergite (Fig. 3), the *urogomphal plate* (Young 1975: 8) characteristically hinged, bearing paired, heavily sclerotized, fixed, 2-branched urogomphi; inner branch apically bifurcate, outer (main) branch bearing 2 large, stout, inwardly projecting protuberances; main branches curved upward at apices. Distal dorsal surface of urogomphal plate with 3 prominent setiferous calli on each side of meson near bases of urogomphi; *urogomphal pit* (Young, *loc. cit.*) lacking. Ventral aspect of 9th tergite (Fig. 4) divided into several plates, similar in form and structure to those of *Pytho niger* Kirby (Böving & Craighead 1931; pl. 54: M). Ventroanterior margin of 9th sternite (Fig. 4) with asperities in the form of a double arch, each arch formed by 5-7 small teeth, arches separated mesally by a distance subequal to that between adjacent asperities of a single arch; 9th sternite not divided longitudinally. Anal opening ventrad, between fleshy lobes.

Systematic Position

The monotypic heteromerous genus *Sphalma* was described by Horn (1872) from adult specimens collected in California. He referred his new *S. quadricollis* to the family Pythidae and provided a short key to the North American genera. Eleven years later, in their classification of the Coleoptera of North America, LeConte and Horn (1883) placed *Sphalma* in the Pythini of their Pythidae. The relative position of *Sphalma* remained unaltered until 1924 when, in his contribution to the Coleopterorum Catalogus, Csiki included the taxon in the Tetratomini of his Serropalpidae. This change has been reflected in subsequent literature, wherein *Sphalma* is treated as a member of the Tetratominae of Melandryidae (Leng 1927; Hatch 1965; Arnett 1968).





Figs. 5-8, Larva of *Sphalma quadricollis* Horn: 5, epipharynx; 6, hypopharynx; 7, thoracic spiracle; 8, an abdominal spiracle.

Figs. 9-11, Pits associated with menta of adult male Pythini (all 100X): 9, *S. quadricollis*; 10, *Pytho americanus* Kirby; 11, *Priognathus monilicornis* (Randall).

The presence of well developed molar areas immediately separates *Sphalma* larvae from those of the Melandryidae as defined by de Viedma (1965) with the exception of *Hallomenus binotatus* Quensel and *Mycetoma*, both of which belong to the subfamily Eustrophinae (*sensu* Crowson 1965). *Mycetoma* (de Viedma, *op. cit.*) lacks preanal asperities and *H. binotatus* (Van Emden 1942, 1943; de Viedma, *op. cit.*) has but a single stout asperity on each side of the 9th sternite. Known larvae of the Synchroidae (*sensu* Böving & Craighead 1931, page 41, pl. 52 and Crowson, *op. cit.*) closely resemble those of *Hallomenus* and also have only a single pair of asperities in association with the 9th sternite. Additional diagnostic characters of *Sphalma* larvae include the lack of hypostomal rods, a cervicosternum which is divided into 3 plates, stout spine-like setae associated with the legs, hinged 9th tergite, and asperities in the form of a continuous double arch. Larvae of the Pyrochroidae (Pyrochroinae), Othniidae, and Salpingidae (Salpingini and Pythini) also have hinged 9th tergites. However, the asperities of pyrochroids take the form of a single arch and the legs are devoid of spine-like setae; the asperities of othniids form a double arch which is broadly discontinuous mesally (distance between arches greater than twice that between adjacent asperities of a single arch); both the pyrochroids and othniids have well developed, divergent hypostomal rods. Within the Salpingidae, only the Pythini agree with *Sphalma* in all of the above characters; the salpingine, *Istrisia rufobrunnea* Lewis (Hayashi 1969), comes close to *Sphalma* and the Pythini, but possesses an undivided cervicosternum.

On the basis of the above data, I submit that the current placement of *Sphalma quadricollis* in the Melandryidae is in error and therefore return it to the salpingid tribe Pythini. Further supportive evidence for my position has been brought to my attention by John Lawrence (*in litt.*) who has pointed out that adult males of *Sphalma* possess parameral struts similar to those illustrated for the Salpingidae by Spilman (1952). Also, a setiferous pit on the mentum of adult males is common to *Sphalma* (Fig. 9) and the Pythini (Figs. 10-11).

Hereafter, definitions of adult Salpingidae (Pythini) must be expanded to account for the laterally margined pronotum displayed by *S. quadricollis*. The following alteration to Arnett's (1968, page 26) key to the Tenebrionoidea and other Heteromera (Key F) should circumvent the problem of properly identifying adult *Sphalma*:

19(18). Prothorax widened toward base, disc with basal impressions; tarsal claws sometimes cleft or appendiculate; elongate or broadly oval beetles .... MELANDRYIDAE
19′ Prothorax narrowed behind and in front; without basal impressions; tarsal claws simple 19A

19A(19). Antennae with last 3 segments forming a short, serrate club; mandibles large, porrect; large beetles (over 50 mm.) .... (TRICTENOTOMIDAE)
19A′ Antennae subclavate with last 6 segments subequally thickened; mandibles normal; moderate-sized beetles (6-10 mm) (see also couplets 9 & 17) .... SALPINGIDAE

I should like to acknowledge the Museum of Comparative Zoology for the loan of an adult male *Sphalma quadricollis*, and to express my thanks to the Coleopterists Bulletin reviewers for their time and suggestions and to Mr. Ralph Gorton of Michigan State University who took the scanning electron photographs of the adult Pythini and *Sphalma* mouthparts. A special note of gratitude is extended to John Lawrence for reviewing the manuscript and for his valuable input.

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NOTES ON THE LIFE HISTORY OF THE TOED-WINGED BEETLE *ANCHYTARSUS BICOLOR* (MELSHEIMER) (COLEOPTERA: PTILODACTYLIDAE)

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ABSTRACT

The life history of *Anchytarsus bicolor* (Melsheimer) in Québec is described: the larvae are aquatic, feed on rotten wood, and require probably 3 years for full growth; 10 larval instars are estimated. Young larvae hatch in early August and overwinter a first time in instars II-III; the second year, they develop to instars VII-VIII and overwinter again; a third year is needed for most larvae to complete their growth, and these overwinter again before leaving the water in early June and pupating under debris along the stream banks. The adults emerge from late June to late July and are nocturnal; mating and ovipositing are thought to occur a few days after emergence.

INTRODUCTION

Anchytarsus bicolor (Melsheimer) is a rare beetle; it is nonetheless widespread, occurring from Georgia to New York (Brown 1972), and Québec (LeSage and Harper 1975). Its aquatic larvae, described by Böving and Craighead (1931), are ordinarily found on submerged decaying logs (Leech and Chandler 1956). The pupae, illustrated by Bertrand (1972), have peculiar abdominal structures known as "gin-traps" (Hinton 1946). The terrestrial adults are brown in colour and usually live near water (Leech and Sanderson 1959).

Those are nearly all the previously known facts about *A. bicolor*. The present note adds data on larval instars, growth of the larvae, pupal period, and adult emergence.

METHODS

Collecting methods were described in detail in a previous work on Elmidae (LeSage 1976); they are briefly summarized here. Larvae were collected every month for 13 months using the "kick-sample" method of Hynes (1961) with two handnets (15 and 37 meshes to the cm). The growth diagram is based on measurements of the length of the pronotum in micrometric units (1 unit = 0.02 mm). Adults were obtained by hand-picking, rearing pupae, and from light trap collections.

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SAMPLING STATION

A more complete description of the sampling station can be found in LeSage (1976). The stream studied (Station 3 of LeSage 1976) is the outlet of the Lac Croche (45°59′ N; 74°00′ W), Station de Biologie de l'Université de Montréal (SBUM) at Saint-Hippolyte, Terrebonne County, Québec (width, 1-6 m and depth, 0.05-0.25 m).

The substratum is covered with decaying pieces of logs and sticks between which the larvae live.

RESULTS AND DISCUSSION

The integument of larval *A. bicolor* is rather bare in comparison with that of other dryopoid larvae, particularly elmids; in these, the number and distribution of piligerous tubercules, setae, and hairs provide good characters which when correlated with the length of the pronotum permit separation of the instars (Berthélemy and deRiols 1965; LeSage 1976). In *A. bicolor*, however, the number of setae is small and relatively constant from one instar to the next: on each tergum are 2 rows of 8 tufts of 2-5 setae; the only exception appears to be the first instar in which the setae are more numerous and distributed irregularly on the tergum. Also, in the first instar there is only 1 apical hook on each anal pseudopod (fig. 1), whereas there are 5-12 in the other instars.

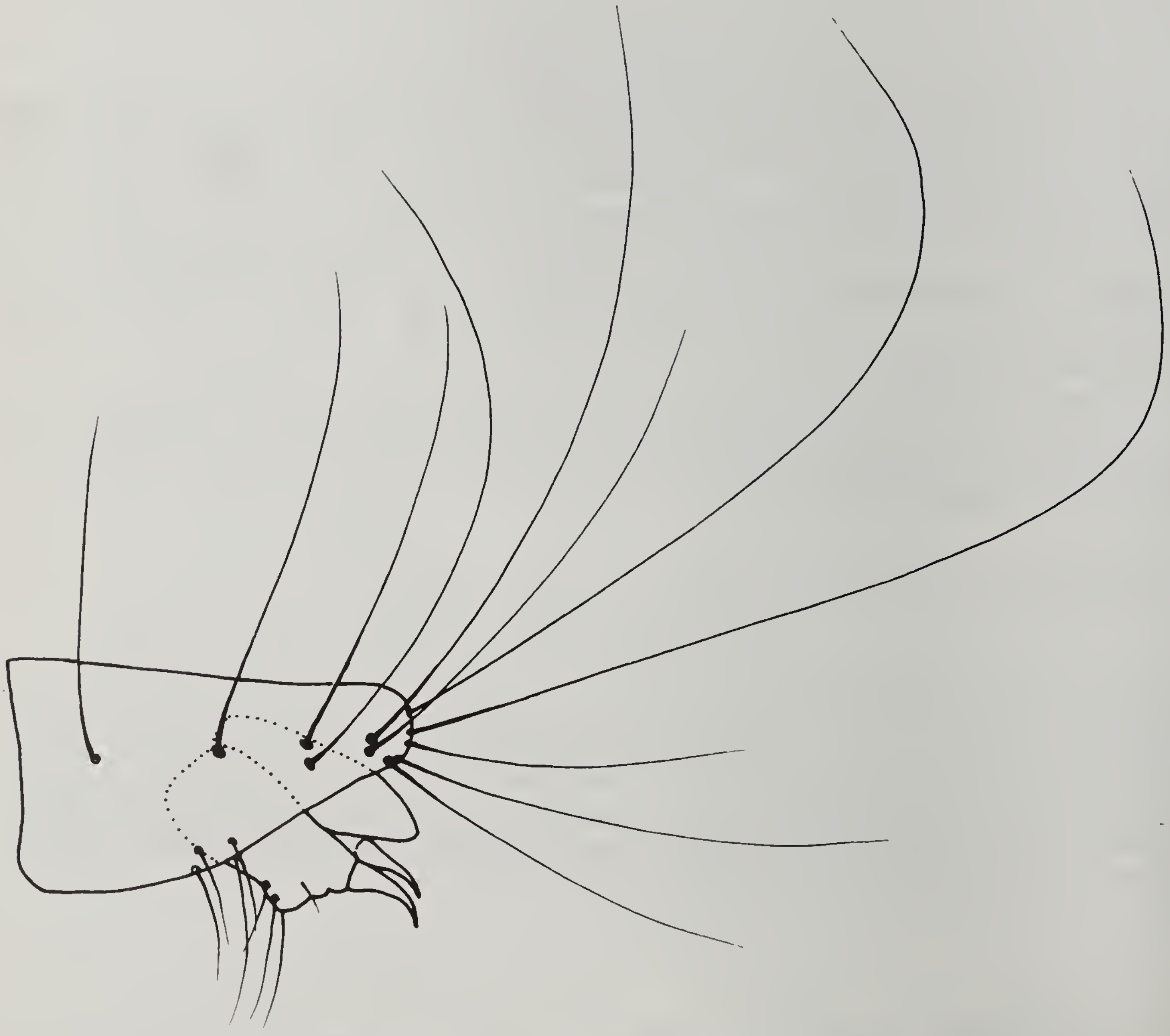

Fig. 1. Lateral view of last abdominal segment of first larval instar.

In the later instars, the more readily observable differences are the darkening pigmentation of the integument and the increasing length of the body. As preserved larvae vary greatly in total body length due to contraction and curving, the most easily measurable structure appears to be the pronotum. The size distribution of the length of this structure has previously been used with success to distinguish larval instars in the Elmidae (LeSage 1976).

The frequency distribution of the pronotal lengths (fig. 2) shows 10 more or less defined peaks which suggest the existence of 10 larval instars. These would be:

instar I, 0.18-0.20 mm (9-10 MU = micrometric units);
instar II, 0.22-0.24 mm (11-12 MU);
instar III, 0.26-0.30 mm (13-15 MU);
instar IV, 0.32-0.36 mm (16-18 MU);
instar V, 0.38-0.46 mm (19-23 MU);
instar VI, 0.48-0.56 mm (24-28 MU);
instar VII, 0.58-0.72 mm (29-36 MU);
instar VIII, 0.74-0.90 mm (37-45 MU);
instar IX, 0.92-1.12 mm (46-56 MU);
instar X, 1.14-1.42 mm (57-71 MU).

The mean lengths of the instars when set on a semi-log plot (fig. 3) indicate a classical larval growth curve.

The larvae represented in the monthly samples (fig. 4) seem to fall into 3 groups. The first group is represented by the youngest larvae (instar I) which are more numerous in early August and also by larvae of instars II-III during the following fall and winter. The second group contains the larvae of instars III-VIII: instar III occurs mainly in spring and early

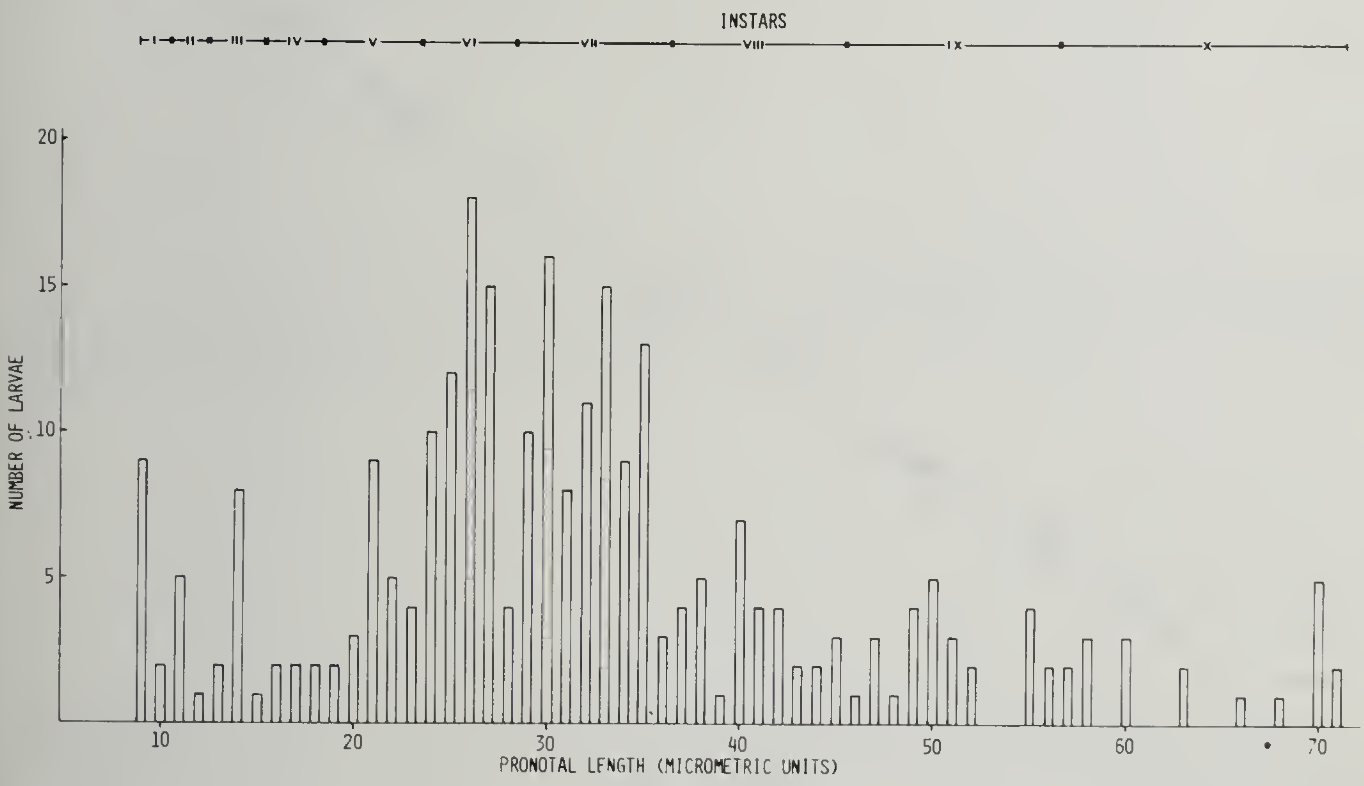

Fig. 2. Frequency distribution of larval pronotal lengths (total number of larvae 278).

summer; growth from instar III to instar VIII is completed from May to September. Throughout the winter months, the relative proportions of the instars remain constant. The larvae of instars VIII-X, the third group, are present throughout the year, but always in small numbers.

These data suggest that most larvae probably require 3 years to complete their growth, though some individual larvae may be able to emerge after 2 years. The small number of large larvae in the samples does not allow a more definite conclusion.

Larval growth of *A. bicolor* is thus very similar to that of some elmids, particularly *Stenelmis crenata* (Say) which also seems to grow for 3 years (LeSage 1976).

Stomach contents of the larvae indicate that they are entirely xylophagous, confirming earlier reports (Leech and Chandler 1956; Bertrand 1972).

We have only 1 record of pupae, on June 17, 1975. However, this sample is very interesting as 4 pupae were found together with 20 full-grown larvae; these larvae when placed in the laboratory on wet sand pupated the next day and all had emerged as adults within 1 week. Before pupating, the larvae lie on their side and assume a comma-shaped position; pupation took place in a pupal chamber built within decaying vegetal materials in cracks of a big rock on the edge of the stream.

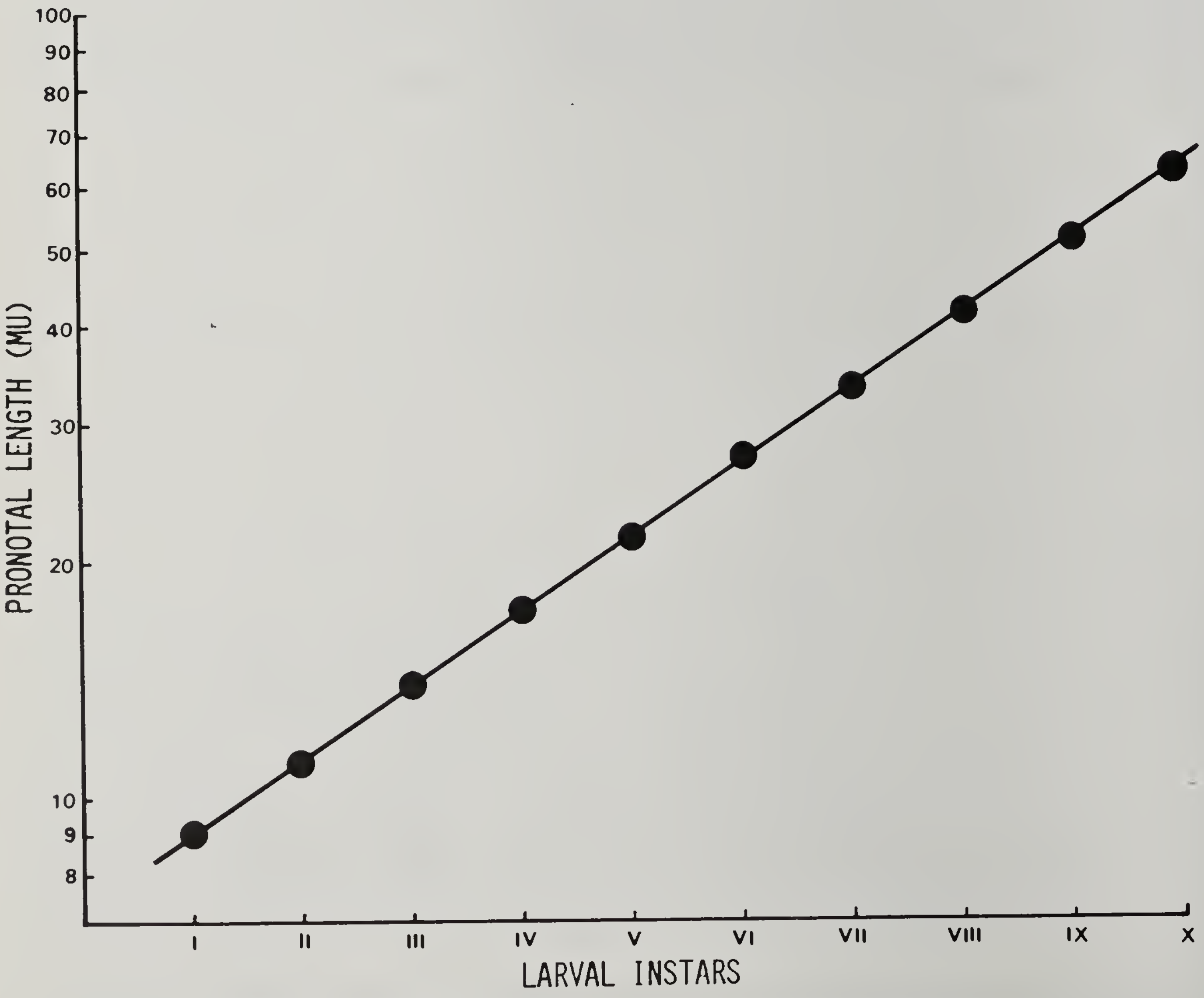

Fig. 3. Growth of prothorax in successive instars.

Pupae of *A. bicolor* have a behaviour nearly identical to that of elmid pupae (LeSage and Harper 1976); both pupate out of water under decaying vegetable materials along banks of streams, and both build a pupal chamber. The pupal period lasts probably 2 to 4 weeks from mid-June to mid-July.

Very few adults were collected in the field as they are nocturnal. Three were captured during the day under leaf litter along the stream; others were attracted to lights at night. The extreme dates of capture are June 27 (day) to July 24 (night). Mating and ovipositing have not been observed, but we assume that they occur at the same period or a little later. This is one of the main differences between the life-cycle of *A. bicolor* and that of elmids, in which the adults wait a year before mating and ovipositing (LeSage 1976). Furthermore, adult elmids are aquatic and can be encountered all year long, whereas those of *A. bicolor* are terrestrial and are only found in late June to late July.

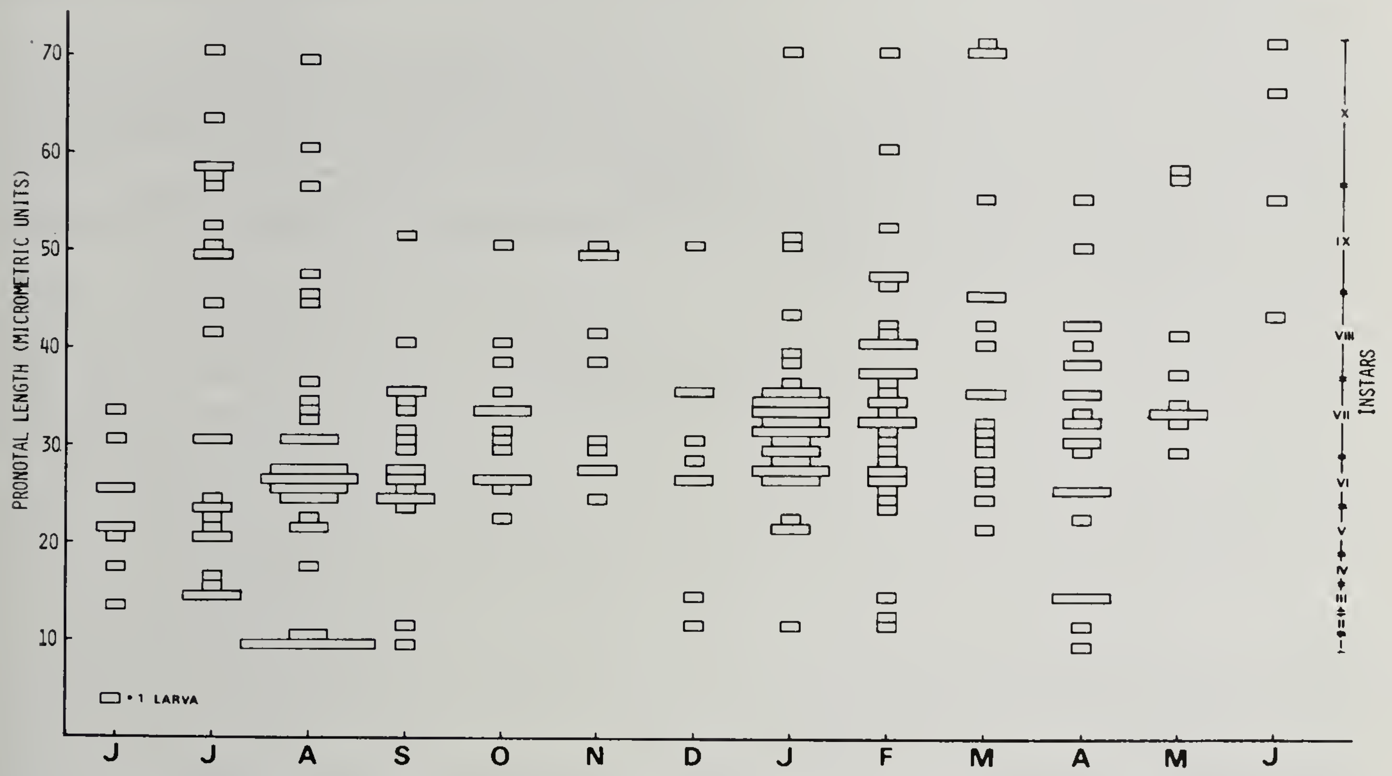

Fig. 4. Growth of larvae based upon frequency distribution of the pronotal lengths from June 1974 to June 1975 (in micrometric units, each equal to 0.02 mm). Total number of larvae: 278.

Acknowledgments

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A NEW SPECIES OF FOSSIL *PTINUS* FROM FOSSIL WOOD RAT NESTS IN CALIFORNIA AND ARIZONA (COLEOPTERA, PTINIDAE), WITH A POSTSCRIPT ON THE DEFINITION OF A FOSSIL

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Abstract

Fossil specimens of *Ptinus priminidi*, new species, are described; they were collected from 3 fossil wood rat (*Neotoma* sp.) middens in the arid mountains of southeastern California and western Arizona. The ptinid specimens lived approximately 12,300, 13,400, and 30,000 years before the present, based on radiocarbon analysis of plant debris found in the midden. Various interpretations of the term "fossil" are discussed. For catalogue purposes, "fossil" may be defined as: A specimen, a replacement of a specimen, or the work or evidence of a specimen that lived in the past and was naturally preserved rather than buried by man.

Ptinid beetles are scavengers of plant and animal matter. Some species are well-known pests of man's stored food products and have been carried to all parts of the world, but most species occur in natural habitats where they live in dead plant matter or in the nests of insects, birds, and mammals. Of all mammal nests, those of rodents have been mentioned most frequently in literature. Perhaps this is because rodents are such prodigious storers of food and thereby provide food for ptinids. Also, the ptinids could be feeding on hair, skin or other body remains of the rodents themselves, and they are known to feed on rodent dung. Linsley (1944) reviewed the subject of natural sources, habitats, and reservoirs of insects associated with stored food products and included a list of ptinids and their associated bird and mammal nests and food caches.

Fossilized ptinids have recently been found in fossil wood rat middens. A midden is a refuse heap, marking the site of a primitive habitation. Wood rats or pack rats, *Neotoma* spp., usually make a den in rock crevices where the nest of soft plant material is constructed. The wood rat midden consists of plant debris, many elements of the local fauna that live and die in the wood rat's den, faunal materials gathered from outside the den, and bones and fecal pellets of the wood rat. Fossil middens, having all this material cemented together by urine, are preserved for thousands of years in crevices protected from natural weathering agents. The contents of a midden can be separated by submerging the midden in water to break down the cement of urine. Some of the plant matter can then be subjected to radiocarbon age analysis, and all contents can be studied to determine preexisting biota (Van Devender and King 1971).

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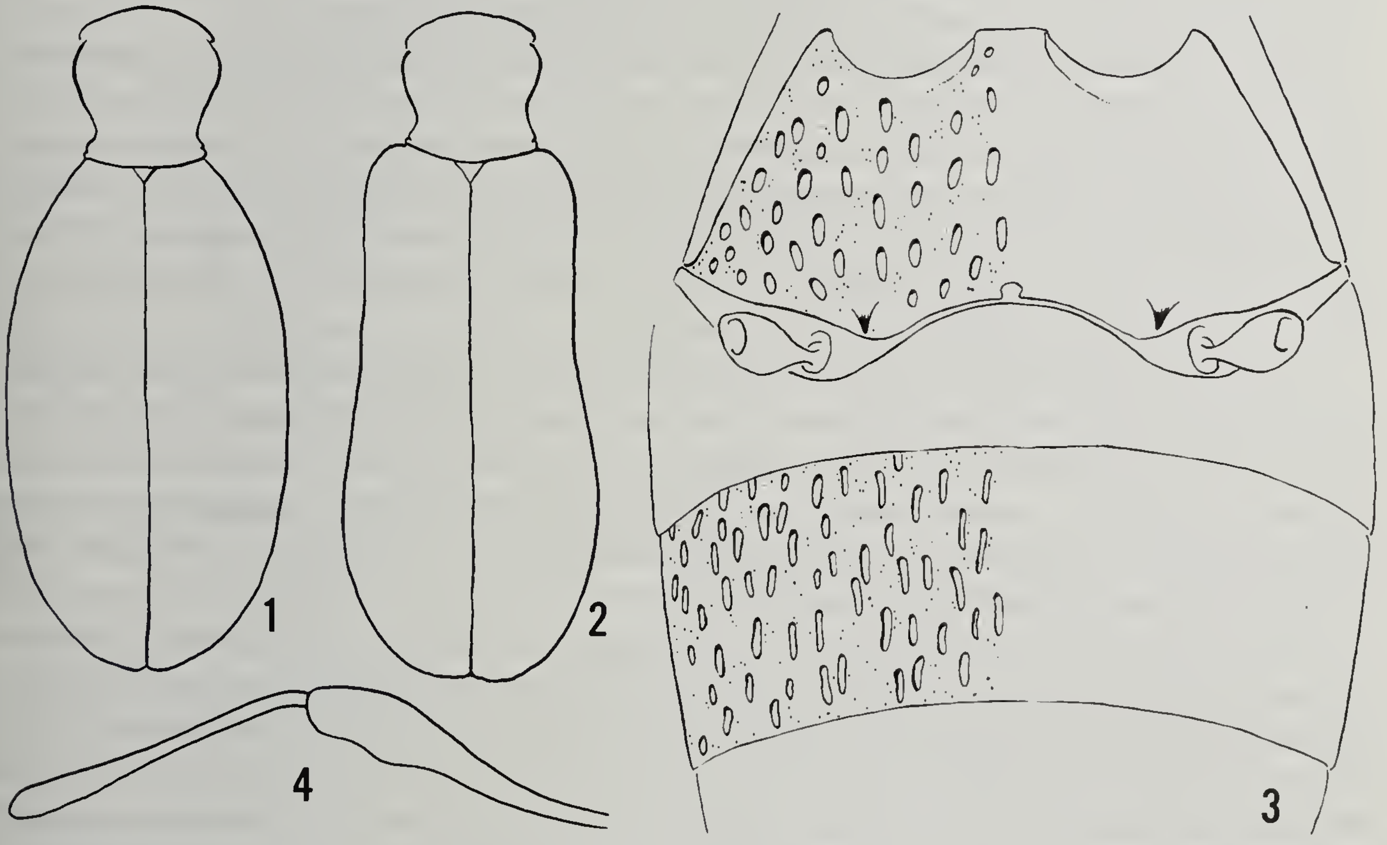
Three families of beetles, including Ptinidae, were recovered from a 11,500—12,500 year old *Neotoma* midden in the Maravillas Canyon of western Texas. The ptinids were *Niptus abstrusus* Spilman, 2 right elytra and 1 left elytron, and *Ptinus* sp., 1 pronotum (Ashworth 1973).

More recently more fossil ptinids have been discovered, this time from localities in the dry mountains of San Bernardino County of California and Yuma and Mohave Counties of Arizona. They are much older middens, based on radiocarbon analysis of included yucca and juniper twigs; the first is more than 12,000 years old, the second more than 13,000, and the third more than 30,000. The specimens, representing a new species, were collected by Thomas R. Van Devender and were submitted for study by Allan Ashworth. The ptinid specimens are in various stages of completeness. All segments of all antennae, except for basal articles in a few specimens, are missing. Legs are rarely present. Unfortunately only a few appressed setae are present on specimens; dorsal setal arrangements are often an important characteristic. A few specimens have a varnishlike coating because of the remains of dried urine, some are slightly distorted, and some have appendages appearing slenderer than usual because of the absence of setae. Otherwise, these ptinids look like complete, recently collected specimens that have had a bit of rough treatment. Only the hard parts of the exoskeleton persist. Each abdomen, when available, was examined for presence of genitalia, but only the sternites were present. I could not find evidence of dermestid beetle damage on external parts, and dermestids were not present in the fossil midden. Perhaps the internal parts and even the abdominal tergites had been destroyed by an organism, perhaps by a fungus.

It is not possible at this time to determine whether this species is extinct. I have merely determined that it is a new species. Perhaps it still lives in the western United States, perhaps even with extant wood rats.

Ptinus (*Ptinus*) *priminidi* Spilman, **new species**

Holotype, female. Lengths: pronotum, .75 mm; elytra, 2.50 mm. *Head.* Eye large, moderately protruding, ventral border straight. Area ventral to eye with curved, sharply incised suture that continues curving outline of anterior and posterior border of eye. *Antennae* (only 4 right articles present). Articles relatively slender; ratio of lengths, with length of article 2 used as the standard: 1—2.1, 2—1.0, 3—1.4, 4—1.8. *Pronotum* (fig. 1). In dorsal view, lateral borders strongly excurved on anterior 2/3 and strongly constricted on posterior 1/3, constriction gradual, not sharply delimited; anterior border strongly excurved; posterior border moderately excurved. Surface with pair of strongly rounded gibbosities; sculptured over-all, without bare areas; with vague longitudinal groove medially; anterior and posterior margins formed by transverse row of coarse punctures that become coalesced laterally to form a continuous, sharp, deep sulcus laterally and ventrally; anterior margin wider than posterior margin; margins with minute granules; surface between granules composed of punctures that are sharply delimited, irregular in shape, and often coalesced; the granules therefore often seem to be quite elevated. Ratio of measurements, with width of constriction used as the standard: width of constriction, 1.00; width anteriorly, 1.40; width posteriorly, 1.20; length medially, 1.60. *Elytra* (fig. 1), In dorsal view oval, sides evenly excurved, widest at half length; humeri rounded; length 1.75 times width. Striae not impressed, composed of sharply incised, coarse punctures that are slightly longer than broad, distance between most punctures in a stria equal to 1—1 1/2 times length of puncture, but punctures slightly smaller and closer together on anterior and lateral parts of elytra; width of puncture approximately 1/3 width of interval in central part of combined elytra; each puncture with minute granule on anterior border and on each lateral border. Intervals mostly flat, slightly convex on lateral areas of elytra, without punctures, each interval with row of fine granules, number of granules on interval slightly less than number of punctures in adjacent stria. *Metasternum* (fig. 3). Width (at posterior border) 3.0 times length (distance between posterior border of mesocoxal cavity and midpoint of posterior border). Posterior border broadly incurved between coxae, at middle with a shallow U-shaped emargination; angulate at medial limit of coxae then slanted anteriorly to lateral border; with a prominent cone-shaped projection slightly lateral to each angulation. Surface with dense oval deeply incised punctures, and with very dense minute granules, each granule with puncture on apex. *Legs.* Left femora and tibiae of all legs, 3 segments of left metathoracic leg, and femur of right prothoracic leg present; legs very long and slender (fig. 4), femora very distinctly expanded apically. *Abdomen.* Visible sternites with the following length ratios, with the 2nd used as the standard: 1—0.58; 2—1.00; 3—0.74; 4—0.26; 5—0.68; the ratio of anterior width to length of 2nd visible sternite is 2.30 to 1. Sternite 2 (fig. 3) with dense, distinctly incised, deep linear punctures, each linear puncture with a minute puncture on anterior border or just anterior to border; surface between linear punctures with dense minute granules, each granule with puncture on apex. Sternite 1 with linear punctures much shorter than on 2, almost oval. Sternite 3 with linear punctures slightly narrower than on 1. Sternite 4 with punctures short, approximately oval, with only a few granules or fine punctures on surface. Sternite 5 with sparse small punctures and granules.



Figs. 1-4, *Ptinus priminidi*, fossil. 1) holotype female, outline, dorsal view. 2) allotype male, outline, dorsal view. 3) metasternum and first two visible abdominal sterna, ventral view, holotype female. 4) left metathoracic femur and tibia, holotype female.

Allotype, male. Lengths: pronotum, 0.8 mm; elytra, 2.6 mm. Surface sculpture as in holotype; differing principally in the eyes and in being much more slender. *Head.* Eyes very large, protruding, rounded ventrally, extending almost to maxillary emargination on ventral surface of head capsule. *Pronotum* (fig. 2). In dorsal view, narrow, lateral borders moderately excurved on anterior 2/3. Surface with pair of weakly rounded gibbosities. Ratio of measurements, with width of constriction used as the standard: width of constriction, 1.0; width anteriorly, 1.1; width posteriorly 1.1; length medially, 1.2. *Elytra* (fig. 2). In dorsal view narrow, sides almost straight in anterior 2/3 and weakly divergent posteriorly; humeri obvious and subangulate; widest at posterior 1/3. Ratio of measurements, with width at posterior 1/3 used as the standard: width at humeri, 0.8; width at posterior 1/3, 1.0; length, 2.1. *Metasternum.* Width (at posterior border) 1.2 times length (distance between posterior border of mesocoxal cavity and midpoint of posterior border). *Legs.* Only left metafemur and metatibia present; very slender.

Paratypes, similar to holotype and allotype except in the absence of body parts, presence or absence of appressed setae on the pronotum and elytra, and proportions of the elytra. The paratypes have been numbered. Paratypes 1-11 and 13 are females, having elytral proportions (length divided by combined widths) 1.67 to 1.80, averaging 1.75. Paratype 12 is a male, having elytral proportions 2.10.

Holotype, female, USNM 73755, and allotype, male: Tunnel Ridge midden #5A, Whipple Mts., elevation 365 meters, 34°13′N–114°22′W, San Bernardino Co., California, dated 12,330±350 years B.P. (A-1582) and 12,670±260 years B.P. (A-1550). Paratypes number 1-12: Burro Canyon midden #1, level 6, Kofa Mts., elevation 853 meters, 33°24′N–114°01′W, Yuma Co., Arizona, dated 13,400±250 years B.P. (A-1315). Paratype number 13: Artillery Mts. midden #3, Artillery Mts., elevation 720 meters, 34°22′N –113°37′W, Mohave Co., Arizona, dated greater than 30,000 years B.P. (A-1100). All specimens were collected by Thomas R. Van Devender and are deposited in the U. S. National Museum of Natural History.

The numbers in parentheses in the foregoing paragraph indicate records in the University of Arizona radiocarbon analysis. Analysis A-1550 is based on *Yucca brevifolia* Engelmann; all others are based on *Juniperus* spp. Artillery Mts. midden #3 was described and analyzed and its location illustrated by Van Devender and King (1971); however, this midden, called midden C. in that article, should now be called midden #3, according to a recent communication from Van Devender.

In extant species the characteristics of the subgenus *Ptinus* are as follows: sexual dimorphism present, that is, male elytra elongate and parallel sided, and female elytra elliptical with the sides strongly arcuate; subbasal pronotal constriction uninterrupted; tomentose cushions on pronotum absent. Of course, the possible presence of tomentose cushions can not be determined on these fossil specimens.

The most obvious feature of this new species is the size of the pair of cone-shaped projections on the posterior border of the metasternum, just anterior to each metacoxa (fig. 2). They are larger than on any other species of *Ptinus* known to me. The projections are never mentioned in descriptions of ptinids and the punctures of the metasternum and abdominal sternites are seldom mentioned because they are usually hidden by the very dense appressed setae that cover the entire ventral surface. The dense setae of any ptinid should be removed in future taxonomic studies; new or unstudied structures might lie hidden but within easy reach.

P. priminidi is similar to *P. fur* (Linnaeus) in the pronotal and elytral proportions and in the punctures of the abdominal sternites; in *P. fur* the punctures of the metasternum are larger, the metasternal processes are absent, the eyes are smaller, and arcuate groove below the eye is absent in the female.

POSTSCRIPT

Are these ptinid specimens and this species to be considered fossil or nonfossil? The question is not easily answered. Most of the beetle, at least, most of the exoskelton is present; it is not a substitute, not a replacement or impression as in the Florissant insect fossils. Perhaps we usually think of an insect fossil as being a permineralization or impression in stone or in amber. These ptinid specimens, I suppose, are similar to the mammoth elephants naturally preserved in a deep-freeze condition in the Arctic permafrost, similar to many of the animals preserved in the La Brea tar pits of southern California, and similar to the mummified giant ground sloth bones and dung from arid caves of the southwestern United States. W. Dwight Pierce (1950) gave many examples of fossilizations that are problems, such as, preservation in Arctic ice, in amber, in thermal spring lime deposits, in peat, and in tar pits. Unfortunately, to his own question of when does a living thing become a fossil, he said that no one can give an adequate answer.

The question of what constitutes a fossil is not academic for North American Coleopterists; we will have to place such species in our forthcoming catalogue in a fossil or nonfossil section, as in the old Leng catalogue, or even, as has been proposed, in a different section, called subfossil. If the category subfossil were used, the following 3 definitions, based on time, would have to be used, according to some paleontologists: a fossil is a specimen, a replacement of a specimen, or the work or evidence of a specimen that had lived in the Pleistocene or before; a subfossil is a specimen, etc., that lived after the Pleistocene but before recorded history; a nonfossil specimen lived during recorded history. The Pleistocene is usually agreed to have ended about 10,000 years B.P. (Before Present), but the beginning of recorded history is not so easily determined. In Egypt and Mesopotamia it probably began 5,000-6,000 years B.P., but in Arizona it began only about 450 years B.P. Surely, the use of the subfossil category in insects would only cause confusion.

What then of the fossil and nonfossil categories? The fossil definition most often recommended to me by paleontologists is admittedly and purposefully vague: a fossil is a specimen, a replacement of a specimen or the work or evidence of a specimen that lived in the past, was naturally preserved, has been dug up, but was not buried by man (usually). The phrase "lived in the past" is interpreted with difficulty, of course, but it excludes the so-called 'fossils-while-you-wait' that can occur when an animal today falls into a tar pit or is covered with lime deposits from a thermal spring. The phrase "not buried by man" would reject as fossils those specimens recently put in the ground for any purpose, but the inclusion of "(usually)" allows acceptance of anciently buried peoples and the insects that might have been in the stored foods buried with a corpse for an after life, or the boll weevil in stored Mexican cotton dated 1,000 years B.P. With fossil and nonfossil lists, a species could be included in either one or both.

Finally, 2 other methods of solving the cataloguing problem have been suggested. First, instead of having fossil and nonfossil lists, we could have lists of extant and extinct species. With that system, a species would be placed in 1 or the other list; however, if a species in the extant list also has fossil representatives, that undoubtedly should be indicated. Second, the fossil question could be avoided completely by having Recent and pre-Recent lists or by having only 1 list and indicating geological time or radiocarbon age beside each specific name.

The fossil and nonfossil lists, even though they present some problems, seem best to me.

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KLEPTOPARASITIC BEHAVIOUR OF *ONTHOPHAGUS SUTURALIS* PERINGUEY (COLEOPTERA: SCARABAEIDAE) AND OTHER DUNG-BEETLES.

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Utilisation by small dung-beetles of brood material gathered by larger species has been reported by several authors. Records relating to the dung-balls of Scarabaeinae have been summarised by Halffter & Matthews (1966) and those relating to the brood supplies of Geotrupidae by Howden (1955). In the present note attention is drawn to these and other previously recorded instances of apparently kleptoparasitic behaviour by dung-feeding beetles. Some new observations are also placed on record and the possible advantages of kleptoparasitism to dung-beetles, particularly under certain environmental conditions, are discussed.

Most records of kleptoparasitic behaviour in dung-beetles relate to Aphodiinae or relatively small Scarabaeinae utilising brood or other material of larger species. More than a century ago, fairly detailed observations were made on *Aphodius porcus* (Fabricius) in Britain by Chapman (1869, 1870). Chapman's observations demonstrated that females of *A. porcus* would enter the egg chambers of *Geotrupes stercorarius* (L.), where they laid up to 10 eggs. Of 29 *Geotrupes* tunnels examined by Chapman (1869), each with 6 to 8 transverse egg chambers at a depth of between 6 and 12 inches, 8 had been visited by *A. porcus*, and a further 6 contained *A. porcus* still at work. *A. porcus* is rather infrequently found above ground in Britain and other observations suggest that this species regularly uses *Geotrupes* burrows and may be dependent on them. Sopp (1898) recorded the presence of another species, *Aphodius testudinarius* (Fabricius), in burrows of *Geotrupes mutator* (Marsham) in Britain. In this instance adults of the *Aphodius* were found in *Geotrupes* burrows during January and February, but were common above ground in dung towards the end of March, when they were *not* to be found in burrows. As *A. testudinarius* probably overwinters in the adult stage, *Geotrupes* burrows may be employed as suitable hibernation sites. If this species does utilise *Geotrupes* egg chambers for oviposition it would seem likely that such behaviour is facultative.

Other recorded instances of utilisation by *Aphodius* species of brood material gathered by larger dung-beetles, relate to the dung-balls of members of the subfamily Scarabaeinae. These cases, all noted by Halffter & Matthews (1966) or Howden (1955), include utilisation of *Scarabaeus sacer* L. balls by *Aphodius* species in France (Fabre 1897), *S. sacer* and *Copris hispanus* L. by *Aphodius* species (and also by Staphylinidae) at Tashkent (Siyazov 1913), *Phanaeus* (probably *igneus floridanus* d'Olsoufieff) by *Aphodius rubeolus* Beauvois in Florida (Howden 1955), and *Onthophagus medorensis* Brown by *Aphodius lividus* (Olivier) in Texas (Howden 1955).

Utilisation of brood material gathered by Scarabaeinae by other, generally much smaller, Scarabaeinae has also been noted for several species. Péringuey (1901, p. 171) records the observations, in Southern Africa, of G.A.K. Marshall, who informed him that "several species, notably *Onthophagus suturalis* and *Onthophagus brevicornis*, utilise the balls made by *Scarabaeus*, & c., penetrating into them while being made. In a ball of *Scarabaeus nigroaeneus* he took no less than twenty examples of *Onthophagus suturalis*." Several other species of Coprini were recorded from dung-balls of *Scarabaeus gangeticus* Laporte in Ceylon by Arrow (1931), including *Caccobius aterrimus* (Fabricius), *C. rufipennis* (Motschulsky), *Onthophagus cryptogenus* Boucomont, *O. ochreatus* d'Orbigny, and *O. pusillus* (Fabricius). Further records are those for what is probably referable to *Caccobius schreberi* (L.) in the balls of *Scarabaeus sacer* L. (Fabre 1897), *Pedaria geminata* (M'Leay) in dung-balls of other Scarabaeinae in Australia (Lea 1923), *Trichillum externepunctatum* Preudhomme in balls of *Dichotomius bosqui* (Pereira) in Argentina (Martinez 1959), *Onthophagus chevrolati* Harold in balls of *Copris armatus* Harold in Mexico (Halffter 1959), *O. suturellus* Brullé in balls of *Gymnopleurus* species (Kolenati 1846), and *O. hofneri* Harold in balls of *Canthon imitator* Brown in Arizona (Young 1969).

All of the specific instances noted above relate to occurrences of relatively small Scarabaeidae, of the subfamilies Aphodiinae or Scarabaeinae (Onthophagini or Coprini) in brood material of larger Scarabaeidae (mostly Scarabaeini, some Coprini) or Geotrupidae. However, it is likely that this type of behaviour is by no means confined to the Scarabaeidae. Several records of dung-feeding species of Diptera from buried brood-balls of Scarabaeidae are noted by Halffter & Matthews (1966), including cases where the Diptera appear to depend on this source of material for oviposition. A number of species of Oxytelinae (Staphylinidae) are also likely to be dung-feeders, both adults and larvae (Hammond, in press), and may construct brood-chambers within dung lying on the soil surface. G. B. Monteith (personal communication) has noted an association between various Staphylinidae and the "nests" of *Cephalodesmius* species in Australia. In particular, individuals of one species of *Anotylus*, which proves to be undescribed (Hammond, unpublished work), have been observed riding on the backs of *Cephalodesmius*, as well as being found in numbers in their buried brood material.

My own observations relate to species of *Onthophagus* collected during the course of the British Museum (Natural History) Entomological Expedition to South-Western Africa 1971-1972. During the course of this expedition samples of herbivorous mammal dung were collected at more than 50 sites in Angola, Botswana, South Africa, and South-West Africa, but no special attempt was made to collect the larger scarabaeoid beetles, or to make observations on the biology of species collected. However, at a locality near the Etosha Pan in South-West Africa an individual of *Scarabaeus nigroaeneus* Boheman was found in the process of rolling a dung-ball, which was collected along with the beetle. The ball was kept in a tightly-stoppered glass jar and some 3 weeks later 2 adults of *Onthophagus suturalis* Péringuey were found to have emerged from it. After a further interval of about 1 week the dung-ball was dissected but was found to contain no further beetle larvae or adults, either of *Scarabaeus* or *Onthophagus*.

Near Sesriem, on the eastern edge of the Namib Desert in South-West Africa, several individuals of the endemic *Scarabaeus rubripennis* Boheman were observed in flight over a system of fairly large dunes. Two specimens were collected from the ground where they were gathering fragments of Gemsbok dung. When found, one of the *Scarabaeus* was carrying an individual of an *Onthophagus* species on its back. The second *Scarabaeus* was seen to land on the ground and, shortly after observation of its dung-gathering activities had commenced, it was joined by an *Onthophagus* which appeared to follow it. Both individuals of the *Onthophagus* apparently belong to the same species. Later attempts to identify the Sesriem *Onthophagus* met with no success, and it is likely that the species, superficially resembling *O. ochreatus* d'Orbigny (from Arabia, North Africa, etc.), remains undescribed.

Although by no means all of the observations noted above are necessarily indicative of kleptoparasitic habits in the dung-beetles concerned, it is likely that utilisation by small dung-beetles of brood or other material gathered by larger species is widespread. Accidental inclusion of other insect species, especially their eggs, in dung buried by large Scarabaeoidea may be relatively frequent, but is clearly not always responsible for the presence of other species in such material. Observations suggest that some species seek out the brood material of large dung-beetles in which to oviposit. The absence of any specific records of predatory dung-inhabiting species (large Staphylinidae, Histeridae, etc.) from scarabaeoid dung-balls may also indicate that the eggs of dung-frequenting species are not often accidentally included in brood material which is later buried.

In some instances the use of buried brood material by adults or larvae of other species may be facultative. In other cases brood chambers may merely provide suitable hibernation or aestivation sites, especially for non-burrowing species. Use may also be made of abandoned brood material as a food source. The presence of an individual of *Onthophagus hofneri* in an abandoned, unburied *Canthon* brood-ball was interpreted by Young (1969) as an example of "eco-system economy", that is the smaller dung-beetle was utilising a convenient food-source which might otherwise have remained unexploited as food for dung-beetles or other insects. However, to be sure that this instance is not indicative of kleptoparasitic behaviour, further data concerning the oviposition behaviour of the *Onthophagus* species and its presence or absence from dung-balls which *are* buried are required.

Where buried brood material is utilised as food for adults or larvae of smaller species the fate of the "host" species' brood may vary. The eggs of the host may be eaten or killed (e.g. *Aphodius porcus*), or host larvae may starve because of depletion of the food store before they hatch. In other cases, where the "kleptoparasites" are particularly small, the host larvae may be little affected. The advantages of exploiting the buried brood material of large scarabaeoids may be several for smaller species. In the absence of competitors and predators buried dung may provide a particularly secure food supply and suitable site for oviposition. Buried dung is also considerably more protected from the vicissitudes of the climate than that above ground. Even in cool temperate regions fluctuations in temperature and humidity of dung above ground are considerable (see Landin 1961). Dessication, especially in exposed situations and in "non-crusting" dung (e.g. that of horses, sheep, etc.), may be rapid. The much greater speeds at which dung dries out in less temperate regions is documented by Hafez (1939), on the basis of studies in Egypt. The predominance of dung-*burying* species in hot and arid regions is, no doubt, associated with the prevailing rapid dessication of their food material on the surface. The life-cycles of small dung-inhabiting species are generally of short duration in the arid Tropics (Hammond, in press). However, the period necessary for the larval development of "medium-sized" species (e.g. *Onthophagus*) is likely to be longer. Brood-chambers constructed immediately beneath dung lying on the surface or brood material in relatively shallow burrows may be insufficiently protected from the rigours of the climate. In extremely arid regions the only herbivorous mammal dung available is likely to be of the non-crusting variety, generally in fairly small pellets. In such circumstances dessication of dung is so rapid that it may only be successfully exploited as brood material by those dung-beetles able to collect and bury it deeply before dessication is advanced. Some large tropical species (e.g. of *Scarabaeus)* bury brood material up to 8 feet below the surface (Arrow 1931). Such dung-balls may also be sealed, for example by a mud coating, and effectively protected from dessiccation. Small species utilising such balls as brood material for their own larvae must enter the dung-ball and oviposit before it is completed and buried. Observations noted above suggest that some *Onthophagus* species may be successful in doing this. Development of such specialised behaviour may be particularly likely to lead to obligate kleptoparasitism. It may be no coincidence that several of the observations of apparently kleptoparasitic behaviour noted here relate to dung-feeding beetles in areas where humidity is low and temperatures generally high. In such regions the brood chambers of large scarabaeoids provide a favourable niche for larval development of smaller species, a niche which may be otherwise scarce or absent.

My thanks are due to M. I. Russell for pointing out the reference to *Onthophagus suturalis*, etc. in Péringuey's (1901) classic work, and to G. B. Monteith for information concerning the habits of the Australian *Anotylus*.

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EDITORIAL–COLLECTING BEETLES IN EXOTIC PLACES WITHOUT LEAVING HOME: THE HERBARIUM[1]

John Colburn Bridwell (1932, J. New York Bot. Garden 33:105-109) long ago published a note on collecting beetles, especially bruchids, in herbaria. This technique needs to be re-emphasized, as a means for gathering much needed complementary data on poorly known groups.

Many bruchids and weevils, and some other groups of Coleoptera and certain other insect groups, leave not only traces of their activity on herbarium specimens but may themselves still be present. Among beetles that attack fruits and flower buds, some leave the food source to pupate in the ground, hence leaving little or no useful, recoverable trace on the herbarium specimen. Others, however, pupate *in situ*; and it is for these that I have found the herbarium a useful—and much neglected—resource.

Recognition. Generally, a distinctive exit hole is prepared, either by larva or adult, before emergence. Frequently, for some reason, the adult has not yet emerged; it may have been physiologically unable to do so, or it may have been trapped during preparation of the plant specimen. In general, unless seeking expected clues, I scan the herbarium sheets quickly; thus, when I do find an infested plant specimen, it is likely to be heavily infested and therefore contain several individuals including fully developed adult males (the most valuable for taxonomic purposes).

Occasionally, plant specimens may be found with emergence holes but no visible beetles, yet specimens are badly needed. In such instances, as with legumes, it may be possible to find infested seeds containing unemerged adults by pinching the apparently intact seeds, or it may be possible to detect seeds containing beetles because of thinned, discolored patches on the seed coat.

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Handling the herbarium material. Herbarium materials are valuable and expensive properties, and must be handled carefully, with permission of the responsible curator. If I find a specimen with visible beetle damage, I look first to the customary pocket on the sheet that contains disassociated plant parts. If there is nothing there, I turn next to the prepared specimen, examining it by microscope for beetles. If seeds or flower buds are well represented, I remove those few of concern to me; if there are few seeds or buds, then I carefully dissect out the beetle, leaving the dissected fruit or bud in a paper pocket associated with the herbarium specimen.

On removal of beetle specimens from the herbarium specimen, an annotation label should be attached to the sheet; this label should later be updated with the correct name of the insect once it is identified. This information may be highly appreciated by the next botanist to examine the herbarium material.

Recording data. In addition to the usual data—locality, date, collector, ecological data, host—one should be sure to record the collector's voucher number. Then, it becomes possible to trace the host plant of a beetle even following changes of name of the host plant or redetermination of the herbarium specimen; the collector's voucher number is the number that is frequently cited in botanical literature. Another advantage of recording this data is that plant specimens are frequently separated and distributed to various herbaria, and with the voucher number it may be possible to trace additional beetle specimens in other herbaria if needed.

Significance. The usefulness of obtaining material in this way is diverse. For tropical beetles, especially, host data are unavailable for most species; from the herbarium specimen we obtain precise host data, associated moreover with voucher material. We may need collaborative data to verify a specimen record; the herbarium may provide an immediate, positive answer. Or we may need to learn something about whether a particular beetle species has relatives in related host plants.

Level of success. One should not expect to find material quickly and easily; hours may pass before success is met. Various factors are involved. The seeds, flower buds, or other plant parts may not be fully ripened, or may have passed their prime. Not all specimens will have an infestation. Botanical collectors are likely to avoid infested specimens. Museum pests may have entered the herbarium and destroyed beetles that may have been there. But, even if it does take some hours to obtain a piece of information, it is more economical to do so from the herbarium than to mount an expensive expedition to some far off land—and success is just as probable.

Some examples. I have used this collecting technique on numerous occasions, first to obtain complementary data on bruchids and, more recently, on weevils. In revising the weevil genus *Rhinochenus,* I (1976, Quaest. Ent. 12:118-201) discovered 2 old specimens that were labelled as from *Copaifera,* whereas all other host records for the genus were from *Hymenaea.* A check of the herbarium confirmed that 1 species of *Rhinochenus* is indeed a seed predator of various *Copaifera,* as I found exit holes on 1 herbarium specimen and actual fragments of the weevil on another.

I am spurred to write this note because in some current studies on another weevil genus, *Apion,* I had material reared from 2 species of *Lonchocarpus* fruits and another from *Pterocarpus* fruits. These plant genera are members of the tribe Dalbergieae *s. l.,* among which the only other records of predation by *Apion* known to me are by the large *A. samson* in fruits of *Andira* (D. H. Janzen, pers. comm.) and by another *Apion* in flowers of *Dalbergia* (D'Araujo e Silva *et al.* 1968, Quarto catalogo dos insetos que vivem nas plantas do Brasil). From a survey of Dalbergieae in the National Herbarium, I obtained additional records of *Apion* from flower buds of *Lonchocarpus, Pterocarpus, Machaerium, Geoffroea,* and *Dipteryx,* and from fruits of *Machaerium.* These will enable me to paint a more accurate picture of host and beetle relationships. The weevils found in flower buds of *Pterocarpus* and in fruits of *Machaerium* are particularly interesting, apparently closely related to one of the weevils reared from fruits of *Lonchocarpus.*

Above all, I want to emphasize here that the technique of collecting in herbaria is not only richly rewarding to all concerned, but also is fun. How else can I collect beetles in Guatemala, Venezuela, and Brazil all in the same day?

I am indebted to Bridwell's paper and to J. M. Kingsolver for introducing me to herbarium collecting; to my artist and technician, Candy Feller, for assistance in searching herbarium materials; and to W. E. Clark and D. H. Janzen for criticism.

—D. R. Whitehead

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NEW SPECIES OF *ELEODES* (*BLAPYLIS*) FROM CALIFORNIA AND NORTHWESTERN MEXICO (COLEOPTERA: TENEBRIONIDAE)

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Abstract

Descriptions are provided for 6 new species, mostly from coniferous forest habitats in montane regions of California and northern Baja California. These new species and *E. caseyi* Blaisdell share a high degree of similarity in the configuration of the male genitalia, and are here designated as the *caseyi* species group. Most members of the *caseyi* group are sympatric with superficially similar species of *Eleodes*, with which they were formerly confused. Such sympatric pairs always show major differences in male genitalia.

In the last 2 decades only 2 new species of the subgenus *Blapylis* were described (Boddy 1957). Recent efforts have disclosed 11 additional species (Somerby 1972) of which 6 are described here. Most of the new species described below were previously identified as other *Blapylis* species with which they are sympatric. The phenetic similarity between members of such species pairs is often quite striking, but all are readily separated by the configuration of the male genitalia. The genitalia of the species described here are incongruous with all but 2 previously known species of *Blapylis*.

The newly described taxa form a distinct group, designated the *caseyi* species group, after *E. caseyi* Blaisdell. Originally, Blaisdell believed *E. caseyi* to be subgenerically misplaced (Blaisdell 1909:390) because of the genital incongruity. The extreme degree of similarity between members of the *caseyi* species group and sympatric members of other species groups suggests that mimetic relationships may be important in *Blapylis*. To facilitate discussion of such relationships, these species are described here apart from a synopsis of the subgenus. A provisional key to the species of *Blapylis* may be found on pages 264-285 of the 1972 dissertation (Somerby 1972). The key is supplemented here by illustrations of male and female genitalia and photographs depicting shape and sculpturing of the pronota, all important diagnostic features.

The name *Eleodes* is derived from the Greek stem *'elaeo'* which means 'an olive' and is feminine. The suffix is derived from the Greek *'odes'* which means 'like' and is masculine. According to the code (Stoll *et al.* 1961:33) "A genus-group name that ends in a Greek or Latin suffix, or in a letter or letters considered as such takes the gender appropriate to its ending." Thus, *Eleodes*, meaning 'olive-like', is masculine. Since the stem of *Eleodes* is feminine most workers including the author of the genus have treated the genus as feminine. In this paper *Eleodes* is treated as masculine.

The species descriptions include 3 ratios: 1) the length of the elytra divided by their greatest width, length measured from last 1/3 of scutellum to tip of elytral apex; 2) the length of the foretibia divided by the length of the pronotum, length of foretibia measured from most proximal point to most distal point (not including the setae along the distal margin), pronotal length measured along middorsal line; 3) the length of the setal pad (as measured along the venter of the probasitarsus) divided by the height of that segment. The preabdominal width of the epipleura is the width of the epipleura at the point where the abdomen joins the thorax.

Eleodes (*Blapylis*) *triplehorni* Somerby and Doyen, **new species**
(Figures 5,22,23)

Diagnosis. *E. triplehorni* is most similar to *E. schlingeri*, new species, *E. cooperi*, new species, and *E. lariversi*, new species. *Eleodes triplehorni* is separable by having the following features in combination: lateral surface of eyes not convex posteriorly; disc of pronotum and elytra shiny; elytral surface with very slight costal indentation, and punctae sublinear; lateral margins of pronotal disc weakly arcuate (Fig. 5); basal humeral area with elytral surface forming an obtuse angle with the epipleura; plantar surface of probasitarsal segment with a short brush.

Holotype male. CAS Type No. 11,439, La Sanja, Sierra San Pedro Martir, Baja California Norte, Mexico, VI-16-1953, collected by J. P. Figg-Hoblyn. Holotype, California Academy of Sciences, San Francisco.

Head. Eyes with lateral surface little convex posteriorly, genal process of moderate length; median lobe of mentum rounded, weakly obscuring lateral lobes.

Prothorax. Notum (Fig. 5) 3.4 mm long, 4.6 mm wide; punctae small, moderately deep, tubercles present next to margin; vestiture inconspicuous and not noticeably hispid laterally; shiny surface. Anterior emargination strong, apical angles obtuse; anterior width of pronotum subequal to posterior width; lateral margin slightly arcuate, non-angulate, basal constriction moderately developed; convexity (as seen in cross section) strong with lateral 1/4 slightly deflexed. Hypomeron with punctae not evident, tubercles small and scattered in basal area, vestiture inconspicuous on shiny surface. Prosternal process moderately developed.

Elytra. Length 9.7 mm, width 6.0 mm; length to width ratio moderate (1.6). Punctae with moderate diameter and depth present medially to laterally, not coalescing in dorsolateral area; punctae and tubercles in incipient rows, tubercles small with most larger tubercles of same size with little size reduction laterally to medially; vestiture hispid on shiny surface, alutaceous network not evident. Elytra slightly expanded basally; planate from base to disc. Elytral apex oval, weakly sloping. Epipleura 0.84 mm wide at base, with faint shallow punctae and fine tubercles over entire surface; alutaceous network absent; basal width moderately expanded compared to preabdominal width, humeral area obtuse, humeri slightly angled.

Venter. Abdominal punctae of moderate diameter and depth, tubercles present on 2nd visible sternite; surface shiny. Foreleg in anterior silhouette with distal, ventral surface of femur weakly curved; tibia with proximal, ventral border not constricted; tibial ratio moderate (0.97), ventrodistal surface of probasitarsus not produced.

Secondary sexual characters. Male with golden tuft of setae on probasitarsus short, ratio 0.37; fine golden setae present in plantar groove of 2nd protarsal segment, present or absent in plantar groove of 1st mesotarsal segment. Paramere, Figs. 22, 23.

Comments. The species is named in honor of Charles A. Triplehorn of Ohio State University. The rarity of examples of the species group to which *E. triplehorni* belongs and the clear discordance of *E. triplehorni* from other species justifies its description from a single male. From a dorsal view the paramere has a median groove which is not evident among other, related species (Fig. 22). This is of interest since *E. triplehorni* is possibly the most primitive member of the subgroup and shares this genital attribute with *E. schwarzi* Blaisdell.

Eleodes (*Blapylis*) *cooperi* Somerby and Doyen, **new species**

(Figures 2, 10, 11, 13)

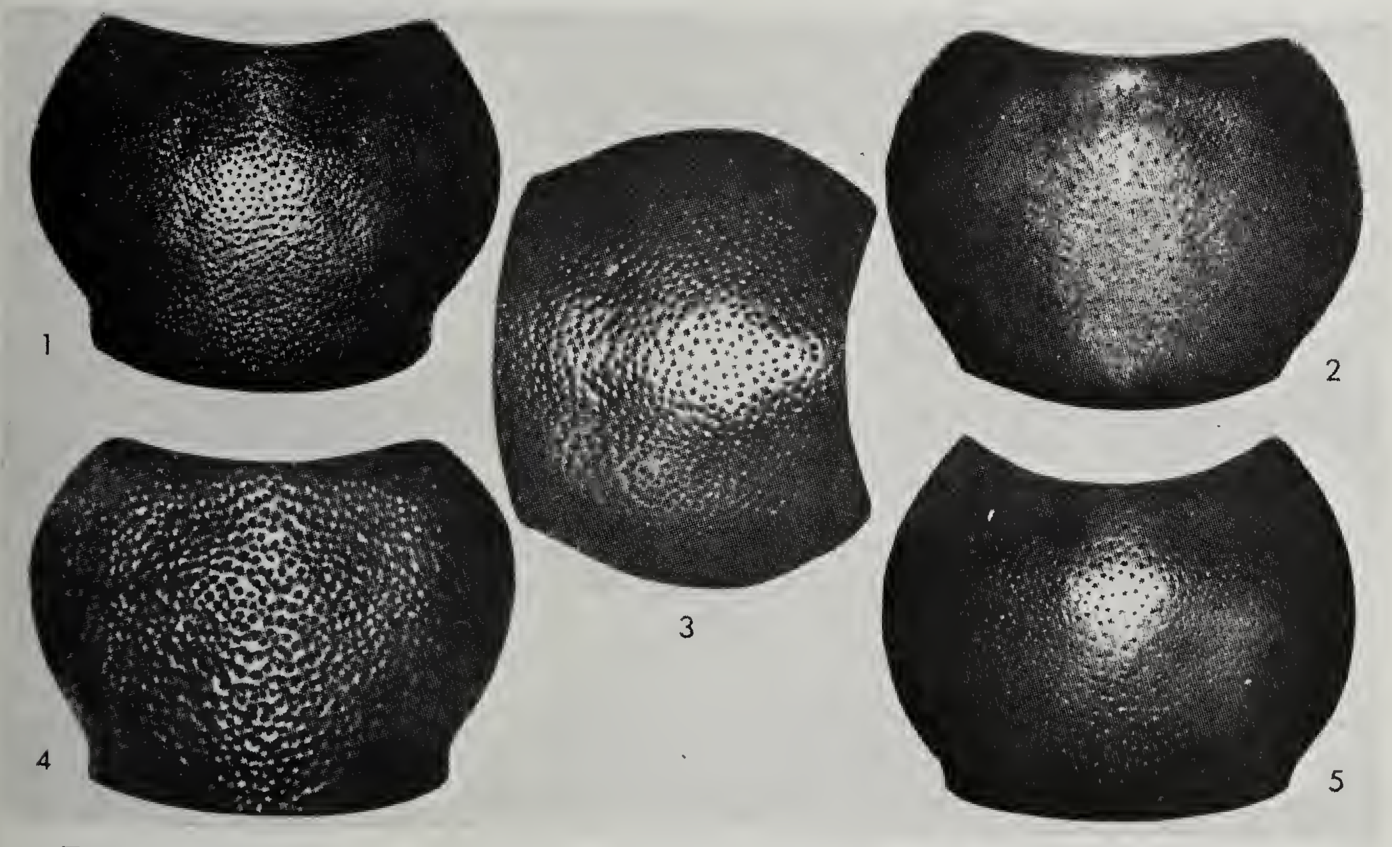
Diagnosis. This species is most easily confused with *E. horni* Blaisdell and *E. fuchsi* Blaisdell. Males are separable from *E. horni* by having a long basitarsal brush; females by having the plantar surface of the probasitarsus uninterrupted by coarse black setae. Males are separable from *E. fuchsi* by paramere shape; females by minor sculpture differences. *Eleodes cooperi* differs from *E. schlingeri*, new species in having shallow small punctae on a matte pronotal disc and rounded humeral area.

Holotype male. CAS Type No. 11,440, Bubbs Creek, Kings River, Fresno County, California, VII-23-1910, collector unknown, from Van Dyke Collection. Exemplar female and 1 female paratype from type locality. Holotype and 1 paratype, California Academy of Sciences, San Francisco; 1 paratype, University of Nevada, Reno. Features of female exemplar which differ from holotype are in parentheses.

Head. Eyes with lateral surface slightly convex posteriorly; genal process of moderate length; median lobe of mentum angular with lateral lobes of mentum exposed (mentum slightly reduced).

Prothorax. Notum (Fig. 2) 2.8 mm (2.9 mm) long, 3.7 mm (4.2 mm) wide; punctae small and shallow, tubercles present on lateral 1/3, vestiture inconspicuous and not noticeably hispid laterally; surface matte. Anterior emargination moderate (slight), apical angles rounded; anterior width of pronotum subequal to posterior width; lateral margin arcuate, non-angulate, basal constriction moderately developed; convexity (as seen in cross section) strong (moderate) with lateral 1/4 evenly arcuate. Hypomeron with puncta-like structures not evident, tubercles small to moderate, restricted to basal area; vestiture hispid on submatte surface. Prosternal process weakly developed.

Elytra. Length 8.0 mm (8.5 mm), width 5.4 mm (6.2 mm), length to width ratio moderate, 1.5 (1.4). Moderately large, shallow punctae present medially to laterally, coalescing in dorsolateral area; punctae and tubercles in incipient rows, tubercles minute (small) with most larger tubercles subequal in size with little size reduction laterally to medially; vestiture pilose on matte surface, alutaceous network not evident. Elytra moderately expanded (slightly expanded) basally, plan-



Figures 1-5, pronota of holotypes of *Eleodes (Blapylis)* species: 1, *E. schlingeri*; 2, *E. cooperi*; 3, *E. bishopensis*; 4, *E. spilmani*; 5, *E. triplehorni*.

ate from base to disc. Elytral apex subobtuse (obtuse), gradually (moderately) sloping. Epipleura 0.6 mm (0.7 mm) wide at base, punctae not evident but with fine tubercles sparse to absent basally; alutaceous network absent; basal width moderately expanded compared to preabdominal width, humeral area rounded (without part of basal, lateral surface of epipleura visible from above), humeri rounded.

Venter. Abdomen with small shallow punctae, tubercles present on 2nd visible sternite on a shiny surface. Foreleg (in anterior silhouette) with distal, ventral surface of femur straight; tibia with proximal, ventral border not constricted, long, ratio 1.11 (moderate, 1.01); distal ventral surface of basitarsus not produced.

Secondary sexual characters. Male with golden tuft of setae on probasitarsus long, ratio 1.0; fine golden setae present in plantar groove of 2nd protarsal segment, and 1st and occasionally 2nd mesotarsal segments. Female with coarse black setae on plantar surface of probasitasus distributed as 2 loosely consolidated lateral rows. Paramere as in Figs. 13, 18; valvifer 2, Figs. 10, 11.

Comments. The species is named in honor of Kenneth W. Cooper, cytologist, geneticist, coleopterist, of the Life Science Department, University of California, Riverside, for encouragement, criticism, and many valued suggestions.

In having relatively long, slender legs, *E. cooperi* is similar to *E. robinetti* Boddy, *E. fuchsi, E. schlingeri,* and *E. lariversi.* The legs of *E. cooperi* are reddish brown rather than black as in all those other species. Examples of E. *cooperi* were previously determined as *E. horni* and *E. fuchsi.*

Ecology and distribution. The examples of *E. cooperi* were taken from the mountains of Fresno, Madera, Mariposa, Plumas, and Tulare counties, California. Specimen labels indicate that they occur from 2100 m to 3400 m elevation. Examples were taken in June, July, and August.

Specimens examined. 8 males; 6 females. California: Fresno County, Huntington Lake, Kings Canyon National Park, Bubbs Creek, Kings River, Bull Frog Lake, Kings River, Middle Fork; Madera County, Buck Camp; Mariposa County, Yosemite National Park, Clouds Rest; Plumas County; Tulare County, Sequoia National Park, Alta Peak, Kings Canyon National Park, Mount Mitchell.

Eleodes (*Blapylis*) *schlingeri* Somerby and Doyen, **new species**

(Figures 1, 14, 15, 18, 19)

Diagnosis. On the basis of external characters, this species is difficult to distinguish from *E. alticolus* Blaisdell. Two differentiating features are very short yet noticeable setae in the central 2/3 of the pronotal disc at 30 × magnification (absent in *E. alticolus*) and the length of the setal pad of the 2nd protarsal segment of males (slightly longer in *E. schlingeri*). The holotype has a setal pad ratio (2nd protarsal segment) of 1.08. This is noticeably larger than the same ratio for an exemplar of *E. alticolus* from Piute Mountain, Kern County, California (0.44) and for an exemplar of *E. alticolus* from Yosemite, Mariposa County, California (0.65). If the setae on the pronotal disc are worn, females of *E. schlingeri* are difficult or impossible to separate from those of *E. alticolus.*

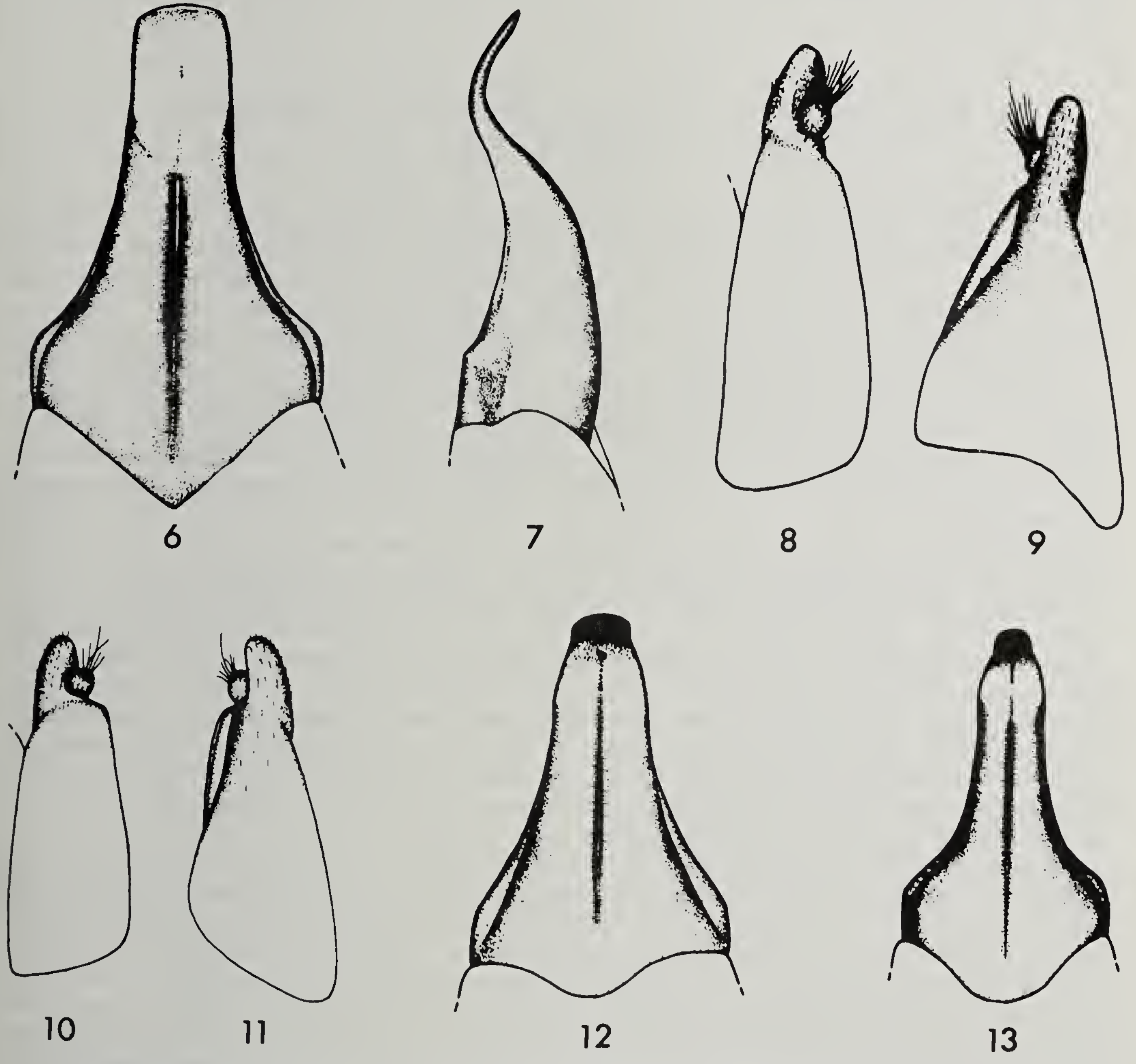
Holotype male, CAS Type No. 11,441, and exemplar female. Giant Forest, Sequoia National Park, Tulare County, California, VII-1-1952, A. Menke, Jr. Holotype male and 19 male, 13 female paratypes from type locality. Holotype and 6 paratypes, California Academy of Sciences, San Francisco; 5 paratypes, Los Angeles County Museum; 15 paratypes, University of Kansas, Lawrence; 4 paratypes, Cornell University, Ithaca, New York; and 2 paratypes, Oregon State University, Corvallis. Features of exemplar female which differ from holotype are in parentheses.

Head. Eyes with lateral surface slightly or not convex posteriorly; genal process of moderate length; median lobe of mentum rounded with lateral lobes of mentum exposed.

Prothorax. Notum (Fig. 1) 3.2 mm (3.6 mm) long, 4.1 mm (5.2 mm) wide; punctae small and shallow, tubercles present on lateral 1/3, vestiture hispid over entire surface, surface submatte. Anterior emargination moderate, apical angles obtuse; anterior width of pronotum subequal to posterior width; lateral margin arcuate, nonangulate, basal constriction strongly (moderately) developed; convexity (as seen in cross section) moderate with lateral 1/4 slightly deflexed (evenly arcuate). Hypomeron with punctae not evident, tubercles small to moderate, present in basal area, vestiture hispid on submatte surface. Prosternal process moderately developed (strongly developed).

Elytra. Length 8.3 mm (9.1 mm), width 5.4 mm (6.6 mm), length to width ratio moderate, 1.5 (short, 1.4). Large, shallow punctae present medially to laterally, coalescing in dorsolateral area; punctae and tubercles evenly distributed, tubercles small with little size reduction laterally to medially; vestiture pilose on submatte surface, some alutaceous lines (alutaceous network not evident). Elytra moderately expanded basally (slightly expanded); planate from base to disc. Elytral apex oval (subobtuse), gradually sloped. Epipleura 0.91 mm (1.04 mm) wide at base, with faint shallow punctae and fine tubercles over entire surface; subalutaceous; basal width moderately expanded compared to preabdominal width, humeral area with a near right angle (obtuse angle), humeri strongly angled (slightly angled).

Venter. Abdomen with moderate diameter, shallow punctae, tubercles incipiently present on 2nd visible sternite on a shiny surface. Foreleg in anterior silhouette with distal, ventral surface of femur straight; tibia with proximal, ventral border not constricted, long, ratio 1.06 (moderate, 0.90); distal, ventral surface of probasitarsus not produced.



Figures 6-13, genitalia of species of *Eleodes* (*Blapylis*): 6, 7, *E. spilmani*, holotype, dorsal and lateral aspects of apical portion of aedeagus; 8, 9, *E. bishopensis*, dorsal and lateral aspects of second valvifer of ovipositor; 10, 11, *E. cooperi*, dorsal and ventral aspects of second valvifer; 12, *E. bishopensis*, holotype dorsal aspect of apical portion of aedeagus; 13, *E. cooperi*, holotype, dorsal aspect of apical portion of aedeagus.

Secondary sexual characters. Male with setal pad (golden tuft of setae) on probasitarsus very long, ratio 1.46; fine golden setae present in plantar groove of 2nd and 3rd protarsal segments and 1st and 2nd mesotarsal segments. Female with coarse black setae on plantar surface of probasitarsus distributed as 2 loosely consolidated lateral rows. Paramere, Figs. 18, 19; valvifer 2, Figs. 14, 15.

Comments. The species is named in honor of Evert I. Schlinger, dipterist, University of California at Berkeley.

Examples of *schlingeri* were previously determined as *E. fuchsi*, *E. alticolus*, and *E. parvicollis* Eschscholtz, but *E. schlingeri* is most similar to *E. alticolus*, with which it is sympatric. Examples of *schlingeri* are taken less often than those of *E. alticolus*. A comparison of the respective parameres (Figs. 18, 19 compared to Figs. 16, 17) clearly shows the considerable divergence between these species.

Ecology and distribution. This species occurs in the mountains of Kern and Tulare counties, California, from 1800 m to 2800 m. Specimens were taken in April through August.

Specimens examined. 72 males, 46 females. California: Fresno County; Kern County, Alta Sierra, Greenhorn Mountains, Greenhorn Summit; Tulare County, Camp Sierra, Kaweah River, Lemon Cove, Mineral King, Monarch Lake, Sequoia National Park, Alta Meadow, Giant Forest, Halstead Meadow, Round Meadow, Sierra Forest.

Eleodes (*Blapylis*) *lariversi* Somerby and Doyen, **new species**

(Figures 20, 21)

Diagnosis. This species is most similar to *E. bishopensis*, new species, from which it is separated by having the hypomeron with tubercles of small to moderate size over the entire surface. *Eleodes bishopensis* has large, dense hypomeral tubercles. *Eleodes lariversi* is also similar to *E. schlingeri* from which it is separated by having the elytral humeral area rounded; *E. schlingeri* has the humeri nearly right-angled.

Holotype male, and exemplar female. Trail, Whitney Portal to Mount Whitney, Inyo County, California, 3140 m, July 3-4, 1954, collector unknown, One paratype, San Bernardino County (Koebele Collection). Holotype and 1 paratype, Los Angeles County Museum, California; 1 paratype, California Academy of Sciences, San Francisco. Features of female exemplar which differ from holotype are included in parentheses.

Head. Eyes with lateral surface slightly or not convex posteriorly; genal process of moderate length; median lobe of mentum angular and slightly reduced.

Prothorax. Notum (as in Fig. 3) 2.8 mm (3.0 mm) long, 3.9 mm (4.0 mm) wide; punctae of average diameter, shallow, tubercles present on lateral 3rd, vestiture hispid over entire surface, surface submatte. Anterior emargination moderate (slight), apical angles obtuse; anterior width of pronotum subequal (slightly reduced) to posterior width; lateral margin slightly arcuate, nonangulate, basal constriction not developed; convexity (as seen in cross section) strong with lateral 1/4 slightly deflexed. Hypomeron with punctae not evident, tubercles small to moderate with tubercles in basal area, vestiture hispid (pilose) on submatte surface. Prosternal process strongly (moderately) developed.

Elytra. Length 7.5 mm (8.3 mm), width 4.5 mm (5.7 mm), length to width ratio moderate, 1.7 (short, 1.4). Moderately large, shallow punctae present medially to laterally (medially to dorsally), coalescing in dorsoslateral area (not coalescing); punctae and tubercles evenly distributed, tubercles small with most larger tubercles of subequal size with little size reduction laterally to medially; vestiture pilose on submatte surface, some alutaceous lines present. Elytra slightly expanded basally; planate from base to disc. Elytra apex oval (subobtuse) moderately sloping. Epipleura 0.52 mm (0.60 mm) wide at base, with faint shallow punctae and fine tubercles; conspicuously alutaceous; basal width subequal to preabdominal width, humeral area rounded (inflated), humeri rounded.

Venter. Abdomen with moderate, shallow punctae, tubercles present on 2nd visible sternite on a shiny surface. Foreleg in anterior silhouette with distal, ventral surface of femur straight; tibia with proximal, ventral border not constricted, long, ratio 1.15 (moderate, 0.99); distal, ventral surface of probasitarsus not produced.

Secondary sexual characters. Male with setal pad (golden tuft of setae) on probasitarsus very long, ratio 1.54; fine golden setae present in plantar groove of 2nd protarsal segment and 1st mesotarsal segment. Female with black setae on plantar surface of probasitarsus distributed as 2 loosely consolidated lateral rows. Paramere as in Figs. 13, 18; valvifer 2, Figs. 20, 21. The apex, linear suture, and base of the paramere in *E. lariversi* are similar to those of *E. cooperi* (13, 18) with the mid-section, from a dorsal view, as in Fig. 22, not as constricted as that of *E.cooperi.*

Comments. The species is named in honor of Ira La Rivers, Professor of Biology, University of Nevada, Reno, who has contributed to our understanding of the ecology, morphology, and distribution of a number of species of Eleodini.

Specimens examined. 2 males, 1 female. California: Inyo County, Whitney Portal to Mount Whitney Trail; San Bernardino County, Koebele Collection.

Eleodes (*Blapylis*) *bishopensis* Somerby and Doyen, **new species**

(Figures 3, 8, 9, 12)

Diagnosis. This species is very similar to *E. strumosus* Blaisdell, *E. caseyi*, and *E. spilmani*, new species. It differs in having the pronotal disc lacking noticeable vestiture laterally and with no setae evident medially. The disc usually lacks a basal constriction. The pronotal punctae are smaller medially than in the other 3 species. *E. bishopensis* is also similar to *E. triplehorni*, *E. cooperi*, *E. schlingeri*, and *E. lariversi*; it is easily separated by having large, dense propleural tubercles.

Holotype male, CAS Type No. 11,443, and exemplar female. Bishop, Inyo County, California, VI (no other data), collected by Dr. A. Fenyes. Holotype and 2 paratypes, California Academy of Sciences, San Francisco; and 1 paratype, University of Utah, Salt Lake. Features of exemplar female which differ from holotype are in parentheses.

Head. Eyes with lateral surface strongly convex anteriorly and posteriorly; genal process of moderate length (short); median lobe of mentum angular with lobe slightly reduced.

Prothorax. Notum (Fig. 3) 2.9 mm (3.0 mm) long, 3.7 mm (4.2 mm) wide; punctae of average (moderate) diameter and moderate depth, tubercles present next to margin, vestiture inconspicuous and not noticeably hispid laterally, surface shiny. Anterior emargination moderate (strong), apical angles obtuse; anterior width of pronotum slightly reduced (reduced) compared to posterior width; lateral margin slightly arcuate (arcuate), non-angulate, basal constriction absent; convexity (as seen in cross section) strong with lateral 1/4 slightly deflexed. Hypomeron with punctae not evident, tubercles large, dense, vestiture hispid on shiny surface. Prosternal process moderately developed.

Elytra. Length 7.9 mm (8.6 mm), width 4.8 mm (5.6 mm), length to width ratio long, 1.6 (moderate, 1.5). Moderate, shallow punctae present medially to dorsally, not coalescing in dorsolateral area; punctae and tubercles evenly distributed, tubercles moderate (small) with most larger tubercles of subequal size with little size reduction laterally to medially; vestiture pilose on submatte surface with some alutaceous lines. Elytra slightly expanded basally; planate from base to disc. Apex oval (subobtuse), moderately sloping. Epipleura 0.58 mm (0.63 mm) wide at base, with faint shallow punctae and fine tubercles; lacking an alutaceous network. Basal width moderately expanded compared to preabdominal width, humeral area rounded (inflated), humeri slightly angled (rounded).

Venter. Abdomen with moderate, shallow punctae, tubercles incipiently present (absent) on 2nd visible sternite on a shiny surface. Foreleg in anterior silhouette with distal, ventral surface of femur straight; tibia with proximal, ventral border not constricted, moderately long, ratio 0.96 (moderate 0.89); distal, ventral surface of probasitarsus not produced.

Secondary sexual characters. Male with golden tuft of setae on probasitarsus long, ratio 1.25; fine golden setae present in plantar groove of 2nd protarsal segment and 1st and sometimes 2nd mesotarsal segments.

Female with coarse black setae on plantar surface of probasitarsus distributed as 2 bundles that partially interrupt plantar groove. Paramere as in Figs. 7, 12; valvifer 2, Figs. 8, 9.

Comments. The species is named after the type locality, Bishop, Inyo County, California.

Examples of this species were previously determined as *E. horni fenyesi* Blaisdell, and constitute part of the original series used in the description of that subspecies. The holotype of *E. horni fenyesi* is a small form of *E. tenebrosus* Horn. Although very similar in shape and size, *E. bishopensis* and *E. tenebrosus* differ in the sculpture of the hypomeron (tubercles large, dense in *E. bishopensis*, small in *E. tenebrosus*). In addition, the setal brush on the probasitarsal segment is long in *E. bishopensis*, minute to short in *E. tenebrosus*. Possibly *E. bishopensis* is a mimetic associate of *E. tenebrosus*.

Ecology and distribution. This species occurs along the streamways on the eastside of the Sierra Nevada from Inyo County to San Bernardino County, California. Examples were taken from March through August.

Specimens examined. 26 males, 30 females. California: Inyo County, Bishop, Independence, Lone Pine, Mazourka Canyon, Sage Flat Public Camp; Mono County, Antelope Springs, Benton, Rock Creek; San Bernardino County, Pinyon Flats (not located on a map).

Eleodes (*Blapylis*) *spilmani* Somerby and Doyen **new species**

(Figures 3, 6, 7)

Diagnosis. *Eleodes spilmani* is most similar to *E. cordatus* Eschscholtz from which it differs by having the hypomeral tubercles large and close. *Eleodes spilmani* differs from *E. strumosus* by having the pronotal vestiture hispid rather than subhirsute or hirsute.

Holotype male, (CAS Type No. 11,444). Mendocino National Forest, California, VIII-4-1958, collected by R. Tappin; exemplar female and 4 male paratypes from Trinity County, Peanut, 5 mi. SE, V-21-1973, collected by J. Doyen. Holotype and 1 paratype, California Academy of Sciences, San Francisco; 3 paratypes, University of California at Berkeley; 1 paratype, California State Department of Food and Agriculture, Sacramento. Features of exemplar female which differ from holotype are in parentheses.

Head. Eyes with lateral surface slightly convex posteriorly; genal process of moderate length (long); median lobe of mentum angular, exposing lateral lobes (median lobe slightly reduced).

Prothorax. Notum (Fig. 4) 3.3 mm (3.0 mm) long, 4.4 mm (4.4 mm) wide; punctae moderate (large), deep, tubercles present on lateral 1/3, vestiture pilose to laterally hispid, shiny surface. Anterior emargination moderate, apical angles obtuse; anterior width of pronotum slightly smaller than posterior width; lateral margin arcuate, non-angulate, basal constriction strongly (moderately) developed; convexity (as seen in cross section) strong with lateral 1/4 slightly deflexed. Hypomeron with punctae not evident, tubercles large-dense, vestiture pilose on shiny surface. Prosternal process moderately developed.

Elytra. Length 8.9 mm (8.8 mm), width 5.9 mm (6.7 mm), length to width ratio moderate, 1.4 (short, 1.3). Moderately large, deep punctae present medially to dorsally, not coalescing in dorsolateral area; punctae and tubercles evenly distributed, tubercles of moderate size with most large tubercles subequal in size with little size reduction laterally to medially; vestiture hispid (pilose) on submatte surface, alutaceous network not evident. Elytra slightly expanded basally; planate from base to disc. Elytral apex oval (subobtuse), moderately strong. Epipleura 0.81 mm (0.82 mm) wide at base, with faint shallow punctae and fine tubercles, lacking alutaceous network; basal width moderately expanded compared to preabdominal width, humeral area obtuse, humeri rounded.

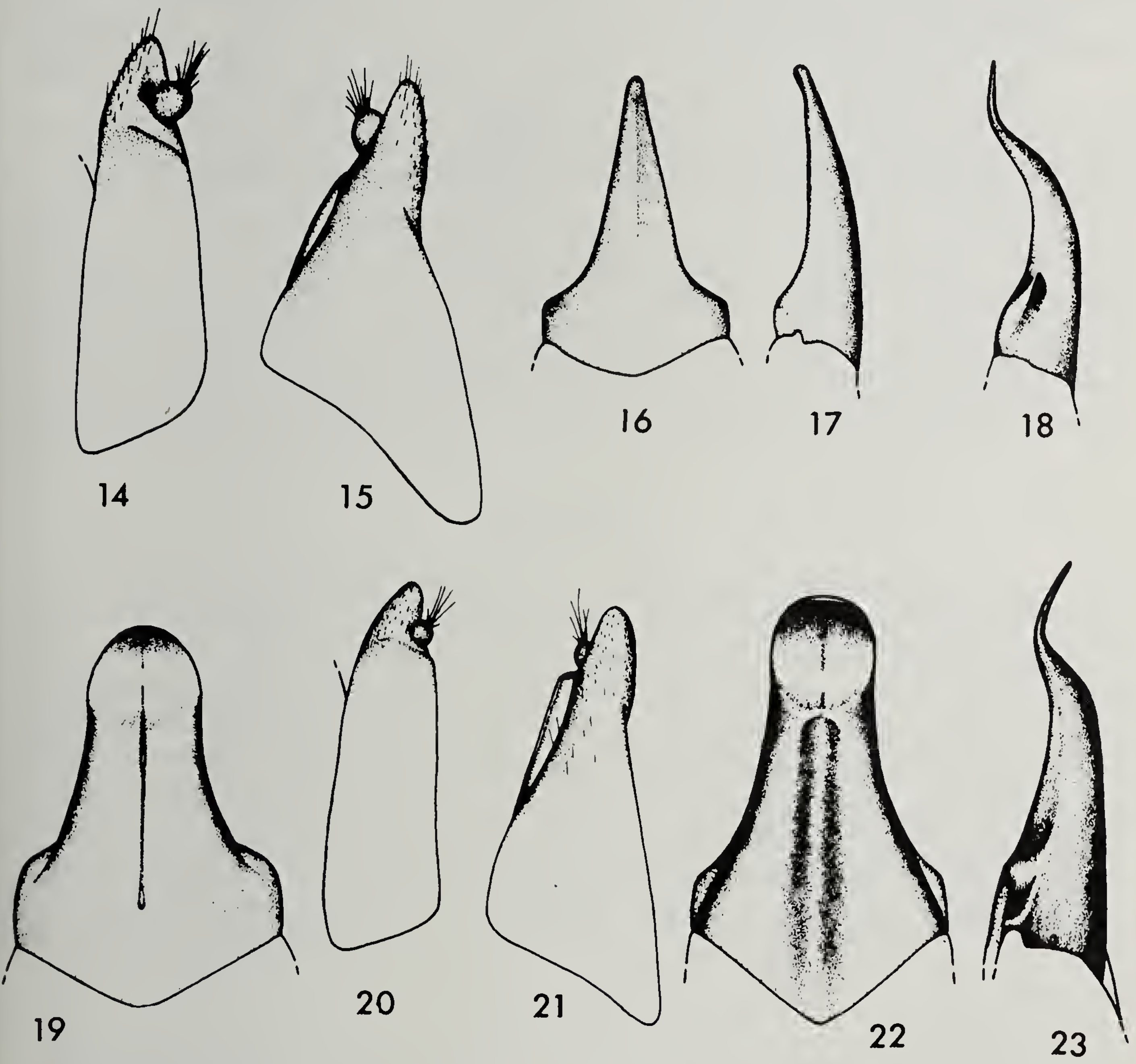
Venter. Abdominal punctae moderate, tubercles present on 2nd visible sternite on a shiny surface. Foreleg in anterior silhouette with distal, ventral surface of femur straight; tibia with proximal, ventral border not constricted, moderate in length, ratio, 0.98 (0.91); distal, ventral surface of basitarsus not produced.

Secondary sexual characters. Male with golden tuft of setae on probasitarsus long, ratio 1.13. Fine golden setae present in plantar groove of 2nd and 3rd protarsal segments and of 1st and 2nd mesotarsal segments. Female with coarse black setae on plantar surface of probasitarsus distributed as 2 bundles that partially interrupt plantar groove. Paramere, Figs. 6, 7; valvifer 2 as in Figs. 8, 9.

Comments. The species is named in honor of T.J. Spilman, coleopterist, U.S. Department of Agriculture, who has shown many kindnesses and has helped in many ways.

Ecology and distribution. Examples were taken in May and August.

Specimens examined. 5 males, 1 female. California: Trinity County, Peanut, 5 mi. SE, Hayfork; Mendocino National Forest.



Figures 14-23, genitalia of species of *Eleodes* (*Blapylis*): 14, 15, *E. schlingeri*, dorsal and ventral aspects of second valvifer of ovipositor; 16, 17, *E. alticolus*, holotype, dorsal and lateral aspects of apical portion of Aedeagus; 18, 19, *E. schlingeri*, holotype, lateral and dorsal aspects of apical portion of aedeagus; 20, 21, *E. lariversi*, dorsal and ventral aspects of second valvifer; 22, 23, *E. triplehorni*, holotype, dorsal and lateral aspects of apical portion of aedeagus.

ACKNOWLEDGMENTS

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DISTRIBUTION OF *COLAPHELLUS HOEFTI* MEN. (COL. CHRYSOMELIDAE) IN NORTHEAST IRAN AND ITS WORLD DISTRIBUTION[1]

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Abstract

In 1975 a survey of northeast Iran around Mashhad was made to determine the distribution of the Polyphagous beetle *Colaphellus hoefti* Men. Isolated populations of the insect were found at Sarachs, Mashhad, Toos, and Neyshabur, but around Kelati-Naderi the beetle was more widespread, feeding on the weed *Cardaria draba* L. and other uncultivated crucifers.

Introduction

The discovery of an extremely restricted infestation of *Colaphellus hoefti* at Toos near Mashhad demonstrated the presence of this pest in Northeast Iran (Sobhian 1975). *C. hoefti* attacks both wild and cultivated Cruciferae (Chesnokov 1936; Rodionov 1924; Romanova 1930; Sakharov 1929; Schreiner 1915; and Uvarov and Glazunov 1916). It is also reported to attack cotton (Plotnikov 1926). To determine the distribution of this pest in Northeast Iran, an extensive survey was conducted in spring 1975; this is the subject of this paper.

Methods

An arid area covering 200-300 km. radius around Mashhad, shown in the detail map (Fig. 1), was studied. Since *C. hoefti* was first found in Toos feeding on *Cardaria draba* L., the search for the beetle was focused on the *Cardaria* plants as well as in all areas with good vegetation along the roads. I searched along the roads shown on the map (Fig. 1) and in the villages near the roads, examining the plants thoroughly for evidence of the beetle, often employing a sweep net. In localities where *Cardaria* grew extensively a systematic sampling plan was carried out. This consisted of surveying plots of about 2500 m^2 every 5 km; but in the 3 successive surveys, each 2500 m^2 area was at a different point. I conducted these surveys semimonthly during the period 15-III to 31-IV-75.

Results

The distribution of *Colaphellus hoefti* appeared to be limited in the region south to southeast of the Hezarmasjed Mountains to only 4 localities: Sarachs, Mashhad, Toos, and Neyshabur. Population sites are shown

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[1] This work was partially funded by the University of Ferdowsi, Mashhad, Iran.

on the map. Population densities in these areas were high, but these areas were exceedingly restricted. In contrast, in regions north of the mountains to which I had access to by road, the beetle was much more widespread; around Kelati-Naderi *C. hoefti* was present at all sites sampled.

DISCUSSION

The population center of *C. hoefti* is located in southern Russia. Rugged mountains, peaking at heights in excess of 3500 m, extend along most

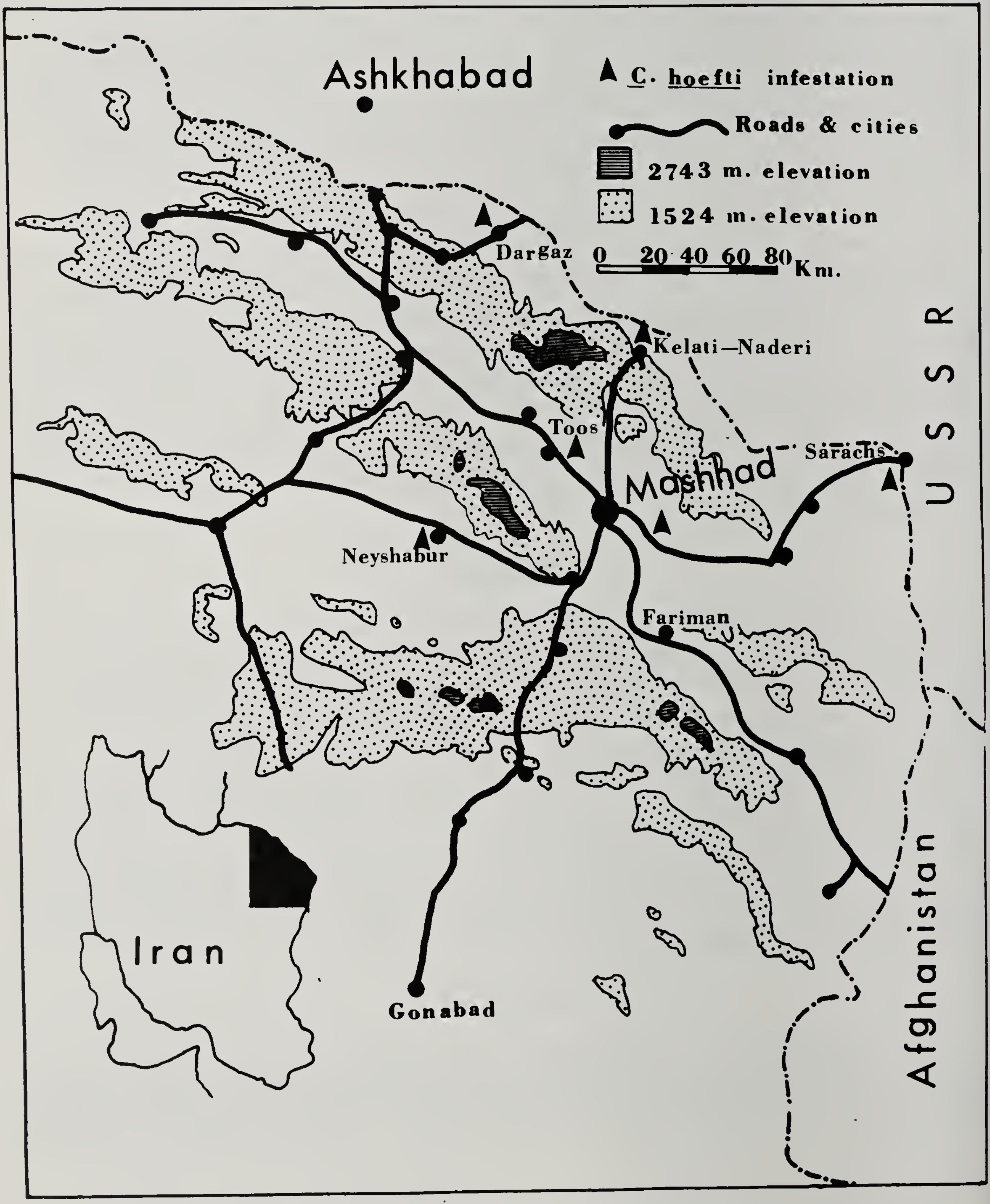

Fig. 1: Map of the area surveyed showing infestations of *C. hoefti*.

of the border between Russia and Iran, but there is a pass between the mountains in the area west of Sarachs. The beetle may have migrated from Russia to Iran through Sarachs and westward through the mountain pass to Mashhad and the surrounding area where it is now expanding its population. But if it is migrating in this manner, then why could I not find it along the road from Sarachs to Mashhad, and also on the way from Mashhad south to Neyshabur and Fariman? Perhaps *C. hoefti* has been accidently introduced into the infested areas by man or other agents; another possibility is that the intervening areas, such as the south side of Mashhad, are unsuitable for development of the beetle. To test suitability of these areas for development of *C. hoefti*, I inoculated the beetle into 2 test areas chosen at random among intervening areas not infested with the beetle, one at the south side of Mashhad and the other in Fariman. I will examine these test areas for presence of the beetle in an effort to better understand the possible invasion into Iran.

World Distribution

A review was made of the world literature on the genus *Colaphellus* and the species *C. hoefti*. As mentioned before, the distribution center of *C. hoefti* is in South Russia and North Caucasus; from there it radiates southward into Armenia, Turkey, and Iran (Balachowsky 1963; Chesnokov 1936; Plotnikov 1926; Rodionov 1924; Romanova 1930; Uvarov and Glazunov 1916; and Weise 1916). According to Weise and others, *C. hoefti* is absent from Middle Europe westward, but another species, *Colaphellus sophiae* Schall. is present (Freude *et al.* 1966). The genus *Colaphellus* is distributed in the Old World north of the equator, with the greatest concentration of species being found in South Russia, the Middle East, and Asia Minor (Balachowsky 1963; Chen 1936; Freude *et al.* 1966; Weise 1916 and 1919; and Winkler 1924-1932). The genus is apparently absent from Southern and Western Hemispheres (R. E. White *in litt.* 1976; Arnett 1963; Lhoste 1934; Leng 1920-48; Blackwelder 1946; and Bechyne 1950).

Many species of *Colaphellus*, including *C. hoefti*, attack cruciferous crops and thus wherever they may occur in the future they pose a potential threat to these plants.

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THE SYSTEMATIC POSITION OF *PECTOTOMA HOPPINGI* HATCH (COLEOPTERA: SCRAPTIIDAE: SCRAPTIINI)

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ABSTRACT

The abrupt postocular constriction of the head, and pubescent tibial spurs of *Pectotoma hoppingi* Hatch make its placement within the Melandryidae (*sensu stricto*) or Tetratomidae (*sensu* Crowson, 1955; Miyatake, 1960) untenable. A discussion of these and additional characters leads the author to propose that *Pectotoma* be placed in the scraptiid tribe Scraptiini.

While sorting through a loan of undetermined Pyrochroidae from the University of Alberta, a series of 3 peculiar specimens (2 males, 1 female) from Waterton, Alberta were brought to my attention by George Ball. They rather closely resembled members of the scraptiid genus *Canifa* with the exception that the males possessed beautifully pectinate antennae not unlike those of male pyrochroids—especially *Schizotus* and *Dendroides*.

Further investigations, including a conversation with John Lawrence, led me to the name *Pectotoma hoppingi* Hatch. Three British Columbian specimens of *Pectotoma*, including 1 paratype, were subsequently forwarded to me by David Kavanaugh of the California Academy of Sciences. These were examined and found to be conspecific with the Waterton material.

Hatch (1965) described the monotypic *Pectotoma* from 5 British Columbian specimens, placing it in the tribe Tetratomini (Melandryidae: Tetratominae). However, close examination of relaxed specimens reveals the following features which preclude the placement of *Pectotoma* within the Melandryidae (*sensu stricto*) or Tetratomidae (*sensu* Crowson 1955; Miyatake 1960):

—head abruptly constricted behind eyes, forming distinct "neck" (easily escapes observation in dried material due to intimate association of head and pronotum).

—base of pronotum narrower than anterior elytral margins.

—penultimate tarsal segments slightly lobed (but not bilobed) on all legs.

—tibial spurs pubescent.

By contrast, the head is not sharply constricted postocularly in the melandryids or tetratomids, the base of the pronotum is rarely narrower than the anterior elytral margins, the tarsi rarely possess lobed segments, and the tibial spurs are serrate (Melandryidae) or simple (Tetratomidae).

Pectotoma may be easily distinguished from the Mordellidae by its simple tarsal claws, the fact that the seventh abdominal tergite is not prolonged posteriorly into a style-like structure, and by the slightly lobed penultimate tarsal segments of all legs. This leaves the family Scraptiidae, with which *Pectotoma* closely agrees in all major characteristics.

In fact, it adheres closely to Franciscolo's (1964) characterization of the tribe Scraptiini of the Scraptiinae.

Franciscolo (1972) enumerated and discussed 10 characters of the Scraptiidae, referring to their presumed "primitivi" and "evoluti" states. *Pectotoma* has been analyzed with respect to these character states which are summarized as follows:

1) pronotum and elytra lacking fine transverse striae (DERIVED).
2) labial and maxillary palpi with apical segments elongate-securiform (PRIMITIVE).
3) all tarsi with penultimate segments slightly lobed, but not bilobed (this feature falls in between the primitive (= linear) and derived (= bilobed or otherwise modified) extremes proposed by Franciscolo).
4) lack of crenulature upon all tibial and tarsal segments (PRIMITIVE).
5) tibiae and meta-tarsal segments with apices transversely truncate (PRIMITIVE).
6) antennae not clubbed (PRIMITIVE).
7) sternites of male devoid of movable appendages (PRIMITIVE).
8) elytral apices separately rounded, not coming together completely along suture (PRIMITIVE).
9) eyes glabrous and deeply emarginate in both sexes (DERIVED).
10) pro-tibiae linear, not apically dilated (PRIMITIVE).

In the same paper, Franciscolo illustrated the relationships between scraptiid genera in the form of a chart. The following genera were assigned to the Scraptiini: *Scraptia* Latreille, *Canifa* LeConte, *Scraptogetus* Broun, *Neoscraptia* Fender, *Trotomma* Kiesw., *Trotommidea* Reitter, *Egydiella* Reitter, *Biophida* Pascoe, *Biophidina* Champion, and *Tolmetes* Champion. On the basis of the characteristics discussed above, I propose that *Pectotoma* Hatch be added to this list of Scraptiini.

I should like to extend my thanks to George Ball (University of Alberta) and David Kavanaugh (California Academy of Sciences) for loans of specimens under their care. A special note of appreciation is extended to John Lawrence of the Museum of Comparative Zoology for confirming my suspicions regarding *Pectotoma* and for making available to me his personal notes on the genus; Dr. Lawrence also offered many helpful observations and suggestions relative to this discussion.

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DESCRIPTION OF THE LARVA OF *PHLOEODES DIABOLICUS* LECONTE (COLEOPTERA: ZOPHERIDAE)

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Abstract

The larva of *Phloeodes diabolicus* (Coleoptera: Zopheridae) is characterized and the relationship of the Zopheridae to other heteromerous beetles is discussed.

The family Zopheridae was first proposed on the basis of larval characteristics of *Phellopsis obcordata* Kirby (Böving and Craighead, 1931). More recently Crowson (1955) and Watt (1967; 1974) have supported the separation of the Zopheridae from the Tenebrionidae because of differences among the adults. The larva of *Phloeodes* is strongly modified for wood boring, most noticeably in the enlarged thoracic region and reduced legs, but in structural details is very similar to that of *Phellopsis*. It may be surmised that other zopherid larvae, at least of the Nosoderminae, will show a high similarity in most of the features described below. Zopherid larval substrates are rotting wood or associated fungus, as far as known. Most are probably nonspecific decomposers. For example, *Phloeodes* is recorded from *Populus*, *Quercus*, and *Morus* (introduced), and probably utilizes many other trees as well.

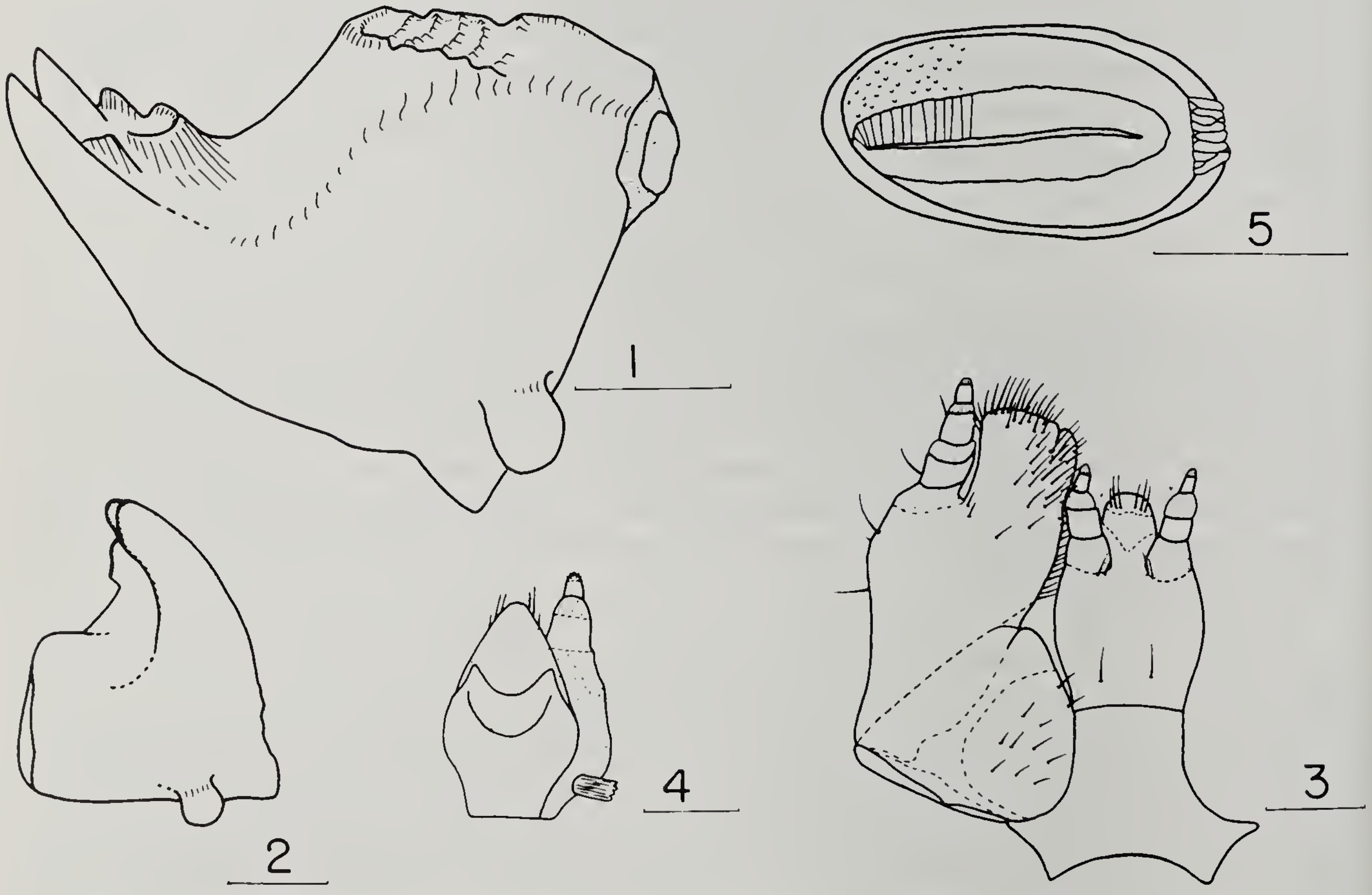
Phloeodes diabolicus LeConte

Intermediate and late instar larva. Body elongate, moniliform when expanded (fig. 6), stout, linear when contracted; desclerotized, white or pale creamy, becoming light tan in preserved specimens; cranium, pronotum, and dorsal sclerites on mesothorax, metathorax, and legs lightly sclerotized, very pale tan, becoming tan in preserved specimens; claws, urogomphi, mandibles, and mandibular, clypeal, and maxillary articulations sclerotized, black.

Cranium (fig. 7) subquadrate, slightly flattened dorsoventrally, prognathous, ocelli absent; cranium glabrous, polished, except for scattered, short setae on dorsal and lateral surfaces and patches of short setae near dorsal mandibular articulations; clypeus desclerotized, whitish, glabrous; labrum protruding anterad, lightly sclerotized, sparsely setose. Antennae articulated with strong prominences on anterolateral margin of cranium; prominences darkly pigmented in mature specimens. Mandibles massive, strongly prognathous; incisor lobe apically bidentate, apical teeth closely subtended by smaller tooth on middle of inner surface and by 2 smaller teeth on dorsal, interior margin (figs. 1, 2); mola massive, with sharp, strong ridge along anterior margin, followed by 3 or 4 weaker, irregular, asperate ridges; posterior half of mola smooth, subplanar; submolar structures absent. Maxilla (fig. 3) thick, fleshy; cardo bipartite, with lightly sclerotized, subtriangular lobe ventrally, more strongly sclerotized, strut-like lobe basally, remainder of ventral surface membranous; stipes lightly sclerotized, continuous with apically incised mala, which is armed with simple setae, densest at apex of inner lobe. Submentum and mentum strongly sclerotized in mature individuals, divided by distinct articulation; prementum membranous except for small sclerites at bases of palpi, continuous with mentum, without distinct articulation; ligula with basal sclerotization, apex densely setose; hypopharyngeal sclerome strongly sclerotized, bilobed, directed anterad (fig. 4).

Prothorax enlarged, flattened, partly enveloping head in contracted specimens (fig. 7); pronotum glabrous, except for extremely sparse, short, erect setae; prosternum transverse, without distinct sutures (fig 8); preepipleurum not apparent, epipleurum as small vertical sclerite articulated with coxa; sternellum reduced, desclerotized. Mesothorax and metathorax similar, transverse, narrow; notal shields with transverse line of flattened, sessile, backwardly directed denticles; sterna fleshy, membranous, transversely connecting coxae. Mesothoracic spiracle enlarged, elliptical, annular-biforous, set in membrane between mesopleuron and propleuron; peritreme slightly elevated, sclerotized; atrium flexible, densely set with fine granules (fig. 5). Metathoracic spiracle small, elliptical, annular-biforous, set in membrane between metapleuron and mesopleuron.

Abdominal segments moniliform, first segment moderately transverse, segments 2 through 8 subquadrate, broadest in posterior third (fig. 6); first 2 segments with transverse line of denticles; nota and sterna of first 8 segments glabrous except for very sparse, short, erect setae; abdominal spira-

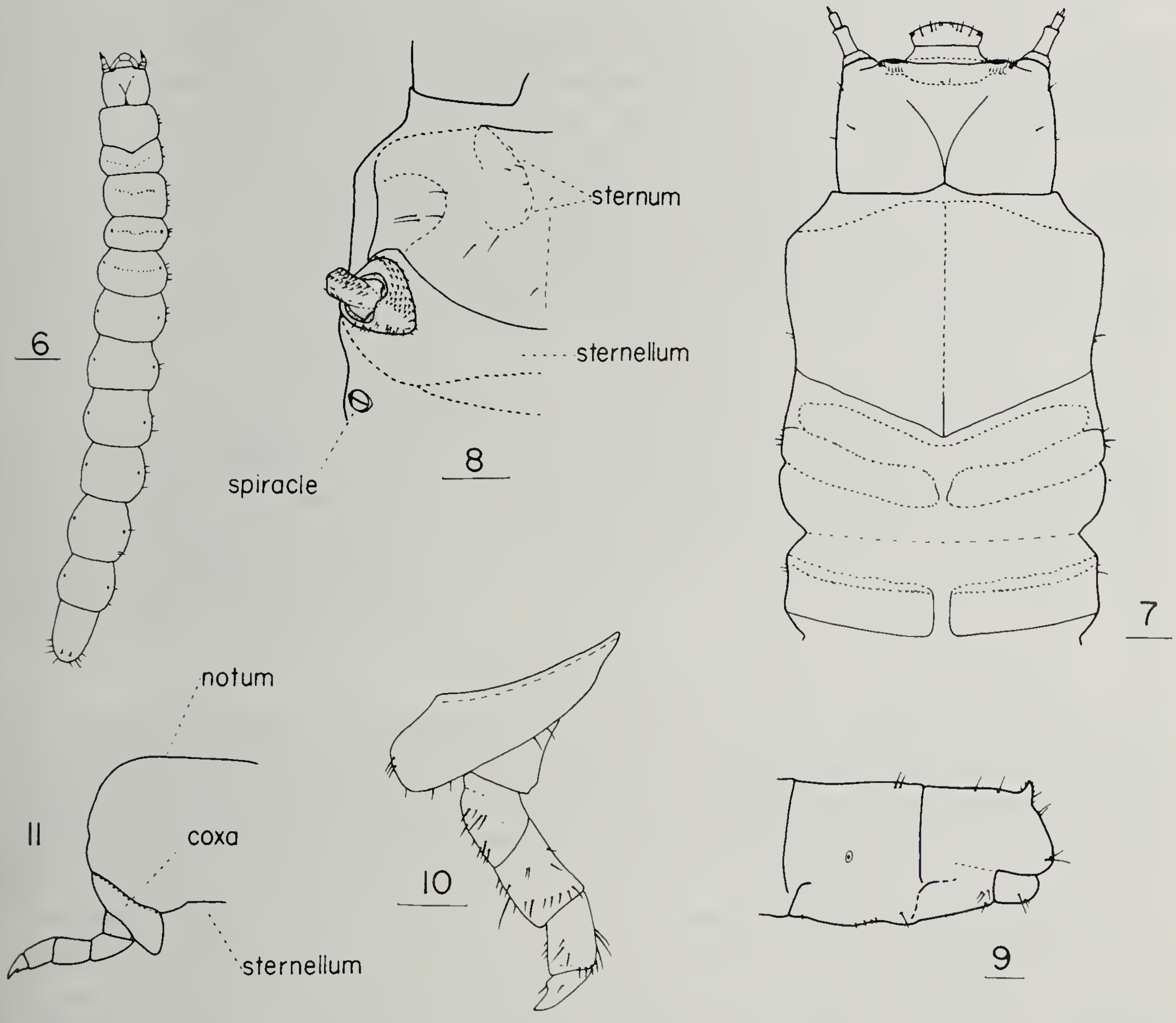


Figs. 1-5. *Phloeodes diabolicus*, mouthparts and mesothoracic spiracles. Lengths of scale lines in parentheses. Fig. 1. Right mandible of late instar larva, oblique ventral aspect (scale line = 1.0 mm). Fig. 2. Left mandible of intermediate instar, ventral aspect (0.5 mm). Fig. 3 Right maxilla and labium of intermediate instar, ventral aspect (0.5 mm). Fig. 4. Ligula and hypopharynx of intermediate instar, dorsal aspect (0.5 mm). Fig. 5. Mesothoracic spiracle, dorsal surface on right (0. 5 mm).

cles similar to mesothoracic spiracle, except for smaller size. Ninth abdominal segment with notum narrow, elongate, subconical, with short, anteriorly curved urogomphi; ninth sternite transverse; tenth sternite transverse, slightly protuberant, without pygopods or exceptional setation (fig. 9).

Legs short, slender, weakly sclerotized; coxae large, transverse, conical, protruding mesally, where trochanter is articulated (figs. 10-11); trochanter, femur and tibia subequal in length, cylindrical; claw colorless, thickened basally, with 2 short setae.

Mature, expanded larvae measure up to 51 mm long in the material examined, but contracted specimens are much shorter. The distribution of head capsule widths in the 13 available specimens suggests that 4 intermediate to late instars are probably represented. Early instars are unknown. The smallest specimens examined differ from more mature individuals in being paler, with less extensive sclerotization of the legs, urogomphi, and mouthpart articulations on the cranium. Dentition of the mandibles is more complex in later instars, with the subapical teeth becoming



Figs. 6-11. *Phloeodes diabolicus*, various larval structures. Lengths of scale lines in parentheses. Fig. 6. Dorsal aspect of late instar larva (2.0 mm). Fig. 7. Cranium and thoracic segments, intermediate instar, mandibles excised (1.0 mm). Fig. 8. Prosternal region, late instar (1.0 mm). Fig. 9. Terminal abdominal segments, intermediate instar, lateral aspect (1.0 mm). Fig. 10. Right prothoracic leg, intermediate instar, posterior aspect (0.5 mm). Fig. 11. Diagram of cross section through prothorax.

relatively larger and the anterior molar surface with parallel rows of asperities (fig. 1). Setation on the cranium, maxillae, and labium is sparser in the smallest specimens, and the spination on the legs is much reduced.

Material examined. California, Riverside County, Riverside, V-13-1971, L. D. Anderson, ex cottonwood (*Populus*) logs (4 larvae; various instars; associated with reared adults); Neuvo, IX-17-1971, ex mulberry (*Morus*) roots (7 larvae, various instars); Monterey County, 6 mi N. Greenfield, V-10-1975, J. Doyen, Ex *Quercus* log (2 larvae, J. Doyen Lot 75E5).

Discussion

The Zopheridae were originally separated from the Tenebrionidae chiefly on the basis of larval maxillary structure (Böving and Craighead 1931). Subsequent workers, while concurring with the separation of the Zopheridae, have not chracterized the larvae or clarified their differences from the Tenebrionidae. Important divergences exist in several features, especially leg and thoracic structure, spiracles, and terminal abdominal segments.

In the Tenebrionidae and Tentyriidae (sensu Doyen 1972) the mala is usually undivided, whereas in the Zopheridae it is apically bifid. This was the differentiating character emphasized by Böving and Craighead. In some Tenebrionidae (some *Eleodes*) the mala is strongly indented apically (Doyen, unpublished) and superficially similar to the condition in the Zopheridae. However, other features of the mouthparts appear to separate the 2 taxa. In most larval Tenebrionidae the mandibles are of relatively simple structure, with 2 or 3 incisor teeth and with the mola of planar configuration. In known zopherid larvae the mandibles have the incisor lobe tridentate (*Phellopsis*) or multidentate (*Phloeodes*), and the mola transversely ridged.[1] In known Tentyriidae the larval mandibles bear a tuft of macrosetae inserted in a dorsolateral or ventrolateral membranous patch, differentiating them from Zopheridae as well as Tenebrionidae. In the Tenebrionidae and Tentyriidae, the labrum is transverse and widest at the base. In the Zopheridae, the labrum is basally narrowed, with the length and breadth subequal (fig. 7). In addition, the ventral mouthparts of the Zopheridae are fleshy, desclerotized, and inflated. In the Tenebrionidae and Tentyriidae the maxillae and labrum are relatively more strongly sclerotized and not inflated or protuberant.

In Tenebrionidae, and especially in Tentyriidae, the larval legs are strongly developed for digging, especially on the prothorax. In the Tentyriidae the contiguous procoxae are enclosed posteriorly by the enlarged sternellum, and the forelegs are directed anteroventrally (Brown 1973; Doyen 1974). In contrast, in *Phloeodes* and *Phellopsis* the legs are relatively small and weak and are attached laterally, with a large intervening sternal region (figs. 8, 11). In both genera the coxae are transversely conical, with the sternellum undifferentiated. Rows of asperities on the thoracic nota are present in various wood-boring beetle larvae including Oedemeridae, Monommidae, and some Colydiidae and are a useful diagnostic feature only in conjunction with other characters.

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[1] As indicated by Watt (1974) some Tenebrionidae (Diaperinae, Phrenapatinae) have the larval mola ridged. It may be significant that these taxa, as in the Zopheridae, inhabit ligneous substrates.

In most Tenebrionidae and Tentyriidae the tenth abdominal segment bears protrusible pygopodial lobes frequently armed with spines or bristles, especially in soil-dwelling forms. In *Phloeodes* and *Phellopsis* the tenth segment comprises a rounded, ventral lobe, without indication of pygopodia (fig. 9).

Affinities of the Zopheridae are not clear. Adult characters suggest relationships with the Tenebrionidae or Tentyriidae (5-5-4 tarsal formula; procoxal cavities closed externally, with a few exceptions; male and female genitalia of tenebrionoid configuration). The absence of defensive glands and external membranes between terminal abdominal sternites, the inverted orientation of the aedeagus, and the relatively large mentum are characters shared with the Tentyriidae (see Doyen 1972). However, as described above, larval characteristics strongly differentiate Zopheridae from both Tenebrionidae and Tentyriidae. In addition, the Tentyriidae are strongly arid adapted organisms, with notable radiations in most of the world's deserts. The Zopheridae almost always occupy woodland or forest habitats and are especially well represented in seasonally wet temperate and montane tropical forests. All known larva of Tentyriidae are soil dwellers, while known zopherids tunnel in rotting wood.

The complex larval mandibular dentition and annular biforous spiracles of the Zopheridae are similar to those of *Othnius*, some Colydiidae, Cephaloidae, and *Synchroa*. *Synchroa* is also similar in maxillary and leg base structure. It is similar to *Phellopsis* (but not *Phloeodes*) in configuration of the frontoclypeal suture and general body configuration. *Synchroa* differs from the Zopheridae in possessing asperities on the 9th sternite, but lacking them on the thoracic tergites. Many of these similarities and differences were informally recognized by Böving and Craighead (1931:190-191) and Peterson (1957:180-183).

No larvae of the Zopherinae have been described. Adults of *Usechus* and *Usechimorpha* (Tentyriidae, Usechini) are morphologically similar to the Nosoderminae. All are associated almost exclusively with decaying wood, where the immatures presumably occur. Description of these larvae will be necessary to complete a characterization of the Zopheridae and to precisely delimit the family.

ACKNOWLEDGMENTS

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NOTES ON THE DISTRIBUTION, SYNONYMY, AND BIOLOGY OF BUPRESTIDAE (COLEOPTERA) OF NORTH AMERICA

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Abstract

The female of *Agrilus sapindi* Knull 1938 is described. *A. mojavei* Knull 1952 is treated as a subspecies of *A. granulatus* (Say) 1823. *A. nodicornis* Fall 1932 is considered a junior synonym of *A. duncani* Knull 1929. New distributional and/or host data are given for 130 species in the following genera: *Paratyndaris*, *Acmaeoderopsis*, *Thrincopyge*, *Agaeocera*, *Hippomelas*, *Nanularia*, *Chalcophora*, *Poecilonota*, *Cinyra*, *Buprestis*, *Melanophila*, *Anthaxia*, *Actenodes*, *Chrysobothris*, *Agrilus*, *Brachys*, and *Taphrocerus*.

As more material has been collected, new information on the biology, distribution, and synonymy of various species of Buprestidae has become available. This adds to our understanding of interfaunal relationships of the United States and Mexico, host plants, and some interspecific relationships.

In this paper the genera are arranged phylogenetically and the species alphabetically under each genus. New larval host records are indicated in boldface letters for specimens either reared from or cut from plants not previously recorded as being a host. Boldface letters are also used to denote new state records in distributional data. For some species new plant associations for adults are recorded even though they may not prove to be larval hosts, and significant extensions of geographical range are recorded though they might not indicate new state records.

Unless otherwise indicated, specimens are in the collector's collection. The abbreviations for collection names follow Arnett and Samuelson (1969). The authors, abbreviated GHN and RLW in this paper, express appreciation to the following individuals and institutions for their help, either in preparing this paper, or in allowing their collections to be included: F. G. Andrews, California Dept. of Food and Agric.; J. H. Baker, Baker, Oregon; W. F. Barr, Univ. of Idaho; R. C. Bechtel, Nevada State Dept. Agric.; F. M. Beer, Corvallis, Oregon; P. J. Clausen, Univ. of Minnesota; N. M. Downie, Lafayette, Indiana; E.M. Fisher, Calif. State Univ. Long Beach; D. Giuliani, Big Pine, California; R. D. Gordon, National Mus. of Nat. Hist.; W. J. Hanson, Utah St. Univ.; R. Heitzman, Independence, Missouri; H. Hespenheide, Univ. of California, Los Angeles; F. T. Hovore, Placerita Can. Nat. Center, Newhall, California; D. H. Kavanaugh, Calif. Acad. Sci.; L. L. Pechuman, Cornell Univ.; B. C. Ratcliff, Univ. of Nebraska; V. Roth, SW. Research Station, Portal, Arizona; L. Russell, Corvallis, Oregon; T. Taylor, Rosemead, California; R. H. Turnbow, Univ. of Georgia; W. H. Tyson, Fresno, California; D. S. Verity, Univ. of California, Los Angeles; J. E. Wappes, Germantown, Tennessee.

Paratyndaris prosopis (Skinner) 1903:237. *TEXAS:* Bastrop Co., Bastrop St. Park, 11,12-VI-71; 14-VII-75; Medina Co., 1 mi E Natalia, Hwy. 35, 12-VII-75, all GHN, on *Quercus stellata* Wang; Brewster Co., Chisos Mts., Pine Canyon, 5000′ 1,2-VII-72, RLW, beaten from dead twigs of *Quercus* sp. The latter record extends the known range of this species about 275 miles westward.

Acmaeoderopsis chisosensis (Knull) 1952:349. This species is known only from the Big Bend area of Texas and no biological information has previously been recorded. *TEXAS*: Brewster Co., 21 mi S Alpine, 4400′, 30-VI-72, RLW; Chisos Mts. Basin, 25-29-VI-63, 24-27-VI-71, GHN, all on *Acacia constricta* Benth.

Acmaeoderopsis hualpaiana (Knull) 1952:349. This species was described from several localities in Arizona and the Colorado Desert of California without ecological data. It has since been collected a number of times in the latter area, always on *Prosopis juliflora* (SW.) DC. We have taken it most commonly flying to plants growing in isolated sandy areas during late morning and early afternoon hours, when temperatures are about 80-85°F, the skies clear, and the wind warm.

Acmaeoderopsis hulli (Knull) 1928:315. This species has been recorded as collected on acacia and *Celtis pallida* Torr. *TEXAS*: King Co., 12 mi W Guthrie, emerged 6-VIII-69, K. Polk, reared from *Prosopis glandulosa* (Torr.) sprayed 1967 with 2-4-5-T [TTCC, RLWE]; Jeff Davis Co., Davis Mts., 6000′, F. Hovore, emerged from *Quercus* sp., VIII-74 [RLWE] (**New host records**). Also taken in *NEW MEXICO*: 5 mi W Las Cruces, Hwy. 70, 16-VI-65, GHN, on *Larrea divaricata* Cav.; 15 mi N Rodeo, Peloncillo Mts., 10-VII-69, GHN, on *Mimosa* sp.

Acmaeoderopsis junki (Théry) 1929:112. This species, widespread in the southwestern United States, has been recorded in Mexico only from Chihuahua. *SONORA*: 2 mi N Santa Ana, 28-VII-57; Alamos, 15/20-VII-58; 22 mi W Alamos, 17-VII-63; 10 mi E Navojoa, 14 & 21-VII-58, all collected by RLW; 15 mi E Navojoa, 12-VIII-73, D. S. Verity; 3 mi NE San Pedro, on road to Ures, 13-VIII-72, D. S. Verity. *SINALOA*: 4 & 12 mi NE El Fuerte, 11 & 12-VII-62, E. Sleeper, *et al.* [CSLB, RLWE]. (**New state records**)

Acmaeoderopsis rockefelleri (Cazier) 1951:9. This species was described from material collected in Texas and Mexico. *NEW MEXICO:* Hidalgo Co., Cienega Lake, 19-VI-64, J. H. Puckle, [RLWE]; 15 mi N Rodeo, 15-VI-65, GHN, all on *Acacia constricta* Benth.; 5 mi W Las Cruces, Hwy. 70, 16-VI-65, GHN, on *Prosopis juliflora* (SW.) DC. (**New state records**)

Thrincopyge alacris LeConte 1858:17. MEXICO, *COAHUILA:* 18.4 mi S Saltillo, 26-VII-75, T. Taylor (**New state record**). This sample differs from those examined from Texas and Arizona in that the dorsal ground color tends to be more greenish and the pronotum often lacks yellow markings along the anterior and posterior margins.

Thrincopyge ambiens (LeConte) 1854:83. MEXICO, *COAHUILA*: 18.4 mi S Saltillo, 26-VII-75, T. Taylor. (**New record, Mexico**)

Agaeocera gigas (Laporte & Gory) 1839:2. This Mexican species was reported from Arizona by Fall (1934); however, this record is suspect and probably refers to *A. scintillans* Waterhouse. Otherwise, *A. gigas* has been recorded only as far north as Durango, Mexico (Waterhouse 1889). *COLIMA*: Armeria, 27-VII-63, RLW, 26-28-VII-56, A. E. Lewis [RLWE, GHNC]; 22 mi SW Armeria, 27-VII-63, RLW. *OAXACA*: 7 mi NE Juchitan, 18-VII-52, E. E. Gilbert, C. D. MacNeil [GHNC]. *MICHOACAN*: 29 mi SW Pihuamo, 24 & 29-VII-66, D. S. Verity [RLWE]; 5 & 12 mi SW Tiquicheo, 1400′ & 2000′, 8 & 9-VII-70, E. Fisher & P. Sullivan [RLWE]; 12 mi S Tzitzio on Huetamo Rd. 19° 21′ N, 100° 50′ W, 10-VII-47, 1050m, T. H. Hubbell [GHNC]. *MORELOS*: 20 mi SE Cuautla, 13-VII-70, E. Fisher & P. Sullivan [RLWE]. (**New state records**)

Agaeocera scintillans Waterhouse 1882:4. This species has been recorded from Texas, Arizona and the Mexican states of Sonora and Sinaloa. The latter 2 were given by Van Dyke (1945), but without specific data. We have seen numerous examples from north of Hermosillo, Sonora to Culiacan, Sinaloa. *CHIHUAHUA*: Santo Nino, 26-VII & 10-VII-68, Sears, Gardner, Glaser [UCDC]; Sierra Madre Mts., La Bufa, 3000′, 8-VII-72, Derham Giuliani [CASC]. *NAYARIT*: 110 mi N Tepic, 19-VII-63, RLW, Jesus Maria, 6,27-VII-55, B. Malkin [GHNC]. **(New state records)**

Hippomelas (*Gyascutus*) *fulgida* Barr 1969:321. This species was described from specimens collected in southwestern Idaho. *OREGON*: Malheur Co., Owyhee River, 17 to 17.7 mi SW Owyhee, 29-VII-71, Westcott & Penrose, on *Salix* sp. [RLWE, ODAC]; 15.2 mi SW Owyhee, 17-VII-74, R. L. Penrose, on *Salix* sp. [ODAC] (**New state record**). The former collections were made between 5 and 8 pm. (MDT) when the beetles were found solitary and mating on the upper portions of the willow. No evidence was found to indicate that this plant serves as a larval host. It is doubtful that it does, since a totally unrelated plant, *Atriplex confertifolia* (Torr. & Frem.) Wats., is known to be a host (Barr 1969).

Nanularia (*Nanularia*) *brunneata* (Knull) 1947:210. Reared from roots and woody stems of *Eriogonum elongatum* Benth., in *CALIFORNIA*: San Bernardino Mts., mouth of Deep Creek, E of Hesperia, GHN. **(New host record)**

Chalcophora virginiensis (Drury) 1772:66. To our knowledge this widespread eastern species has not previously been specifically recorded from *TEXAS*: Harris Co., 3 mi SW Westfield, 27 and 28-VI-61, RLW; Harrison Co., Caddo Lake St. Park, 8-VI-71, GHN, on *Pinus* sp.; Montgomery Co., 16-VIII-58, H. R. Burke, dead pine [GHNC]. **(New state record)**

Poecilonota californica Chamberlin 1922:52. Evans (1957) recorded this species only from Washoe Co. in northwestern Nevada. It was taken in northeastern *NEVADA*: Elko Co., Ruby Mts., Angel Lake Camp, 15-VII-75, J. H. Baker [JHBC, GHNC].

Poecilonota montana Chamberlin 1922:63. *MINNESOTA*: Koochiching Co., T71, R24, S35, 30-VII-59, R. T. Franklin (**New state record**). This represents a considerable eastward range extension. The specimens are not typical of those seen from more western localities and further collections are needed to more adequately define their relationship.

Cinyra gracilipes (Melsheimer) 1845:145. *NEBRASKA*: Lancaster Co., Roca, 4-VII-1899 [DEUN] (**New state record**). This represents the westernmost recorded occurrence of this insect.

Cinyra cuprescens Knull 1940:363. One male on *Anisacanthus thurberi* (Torr.), *NEW MEXICO*: Hidalgo Co., Peloncillo Mts., Granite Gap, 18 mi N Rodeo, 8-VIII-74, GHN. **(New state record)**

Buprestis adjecta (LeConte) 1854:17. *MONTANA*: Ravalli Co., Darby, Trapper Peak [UIMC]; Darby [DZEC]. **(New state record)**

Buprestis confluenta Say 1823:159. *ARKANSAS*: 7 mi E Ash Flat, 1-VII-70, R. J. Leudtke [RLWE]. **(New state record)**

Buprestis consularis Gory 1841:120. *NEBRASKA*: Thomas Co., Halsey, 25-VII-69 [GHNC]; 25-VII-69, R. J. Leudtke [RLWE]. **(New state record)**

Buprestis intricata Casey 1909:118. MONTANA: Glacier Nat'l. Park, Two Medicine, 12-VIII-64, R. H. Ross [RLWE]; Flathead Co., Echo Lake [DZEC]; Bitteroot Nat'l. Forest, VII-65, G. R. Pieper [GHNC]. *ARIZONA*: Coconino Co., Sitgreaves Nat'l. For., Sandpoint, 2-VI-71, H. A. Pase, on *Pinus ponderosa* Dougl. foliage [GHNC]; near Flagstaff, Ft. Valley Exp. For. Headquarters, 23-VI-59, W. L. Nutting [GHNC]; Mohave Co., Hualapai Mts., 9-VI-41, Ernestine Hall [FMBC]. **(New state records)**

Buprestis langii Mannerheim 1843:237. *WYOMING:* Wind River, 1-VIII-72, D. Gates [GHNC]. **(New state record)**

Buprestis maculativentris Say 1824:272. *NEBRASKA*: Sioux Co., War Bonnet Canyon [DEUN](**New state record**). *MONTANA*: Custer Co., Miles City, 11-VII-70, R. C. Stephens [CSLB], confirms a single listing by chamberlin (1926).

Buprestis prospera Casey 1909:123. *UTAH*: Kane Co., Coral Pink Sand Dunes, 1-VII-67, RLW (**New state record**). ARIZONA: Coconino Co., N. Rim Grand Canyon, 14-VI-61, Fred G. Andrews [RLWE]; Flagstaff, 8-VII-41, R. H. Beamer [GHNC]; Gila Co., Sierra Ancha Mts., VII, D. K. Duncan [GHNC]. This species was synonymized with *B. aurulenta* L. by Helfer (1941), but Knull (1947) considered it a valid species. We accept the latter position. Certainly, much more material is needed for study.

Buprestis rufipes Olivier 1790:16. *ALABAMA*: Auburn, 9-VIII-58, H. G. Good [GHNC]; Alex City, 26-VI-58, trap light [GHNC]. **(New state record)**

Buprestis subornata (LeConte) 1860 (1859):208. NEBRASKA: Sioux Co., Glen, 4000′, 10-VIII-06, R. H. Wolcott, on *Pinus* sp. [DEUN]; Thomas Co., Halsey, 30-VII-69 [GHNC]. **(New state record)**

Melanophila (*Phaenops*) *californica* Van Dyke 1918:54. Collected on pine in *NEVADA*: Douglas Co., 5 mi E Stateline, 25-VI-68, RLW; Washoe Co., Galena Creek, 6000′, 30-VI-67, R. C. Bechtel, D. L. Horton [NSDA]. **(New state record)**

Melanophila (Phaenops) drummondi (Kirby) 1837:159. *CALIFORNIA:* Riverside Co., Banning, 21-XI-74, E. Reeves & G. Foster, reared from *Cedrus deodara* Loud. [CDAE, RLWE]. **(New host record)**

Melanophila (Phaenops) gentilis Le Conte 1863:42. Another wide-ranging, common western species. *NEBRASKA*: Sioux Co.: Monroe Canyon, 22-VI, R. H. Wolcott [DEUN]; Pine Ridge, VII [DEUN]; these confirm the record listed by Chamberlin (1926).

Melanophila (*Phaenops*) *intrusa* Horn 1882:105. *NEBRASKA*: War Bonnet Can. [DEUN] (**New state record**). *WASHINGTON*: Pend Oreille Co., Metaline Falls, VIII-30, Gibson, reared from limb *Larix occidentalis* Nutt. [GHNC]. **(New host record)**

Melanophila (*Phaenops*) *obtusa* Horn 1882:106. This species has been recorded only from Georgia and New York. *LOUISIANA*: Livingston Parish, 1.2 mi W Holden, 16-V-69, RLW, beating live *Pinus* sp.; *ALABAMA*: Grand Bay, VI-07, H. P. Loding [CASC] (**New state records**). One other specimen of this apparently rare species is in the CASC from *NEW YORK*: Bear Mountain, 5-VII-25, F. M. Schott.

Anthaxia (s. str.) expansa LeConte 1857:44. *MONTANA:* Flathead Co., Hungry Horse; Bigfork. Lake Co., Mission Mts.; Flathead Lake, Yellow Bay; Polson. Missoula Co., Seeley Lake; 10 mi W Ovando. Powell Co., Pipestone Pass, 6000′. Ravalli Co., Florence. Sanders Co., Thompson Falls; Paradise, Plains; Rainbow Lake. All collected on flowers by Loren Russell. *NEBRASKA:* War Bonnet Canyon, 27-V-01. Sioux Co.: Pine Ridge, 26-V-01; Hot Cr. Valley, 1-VI-01. All collected by R. H. Wolcott [DEUN]. **(New state records)**

Anthaxia (*Haplanthaxia*) *fisheri* Obenberger 1928:255. *NEBRASKA*: Lancaster Co., Hickman, 19-VI-69, B. C. Ratcliffe [GHNC]. **(New state record)**

Anthaxia (*Haplanthaxia*) *viridifrons* Gory 1841:284. *NEBRASKA*: Lancaster Co., Hickman, 10-VI-69, R. J. Luedtke [GHNC]. **(New state record)**

Actenodes mendax Horn 1891:46. In his discussion of this species Fisher (1942) referred to a specimen mentioned by Horn from Illinois as being probably mislabelled, since it was primarily known from Texas on *Prosopis juliflora* (SW) DC. However, a pair taken from a swimming pool under a *Gleditsia triacanthos* L. tree, *MISSOURI*: Raytown, 24-VI-75, D. E. Nelson [GHNC] and another, Lee's Summit, 18-VII-47, B. E. White [CASC] on the same species of tree, indicate that honey locust is probably another host for this beetle and the Illinois record is therefore quite possible. *NEW MEXICO:* Otero Co., Alamogordo, 11-VII-70, Bill Apperson [EMUS]. **(New state records)**

Chrysobothris analis LeConte 1860 (1859):238. Reared from *Cercis reniformis* Engelm., *TEXAS*: Real Co., 5 mi E Camp Wood, GHN, wood collected 2-VII-71, adults emerged 4-VIII-71 to 7-I-73; and from *Pithecolobium flexicaule* (Benth.) Coult., *TEXAS*: Starr Co., 2 mi W Sullivan City, GHN, wood collected IV-74, adults emerged 15-VII to 19-IX-74 **(New host records).** Also taken in MEXICO, *SONORA*: 15 mi E Navojoa and 22 mi W Alamos, 17-VII-63, RLW. *SINALOA*: 5 mi N Mazatlan, 10-VIII-65 and 19-VII-72, GHN; 22, 27-VII and 1-VIII-73, E. Giesbert [Giesbert Collection, RLWE]; Las Flores, 40 mi SSE Culiacan, 24-VII-71, E. M. Fisher [RLWE]. *OAXACA*: 18 mi E La Ventosa Jct., Hwy. 190, 21-VII-65, GHN; and 3 mi W Tehuantepec, 9-VII-65, GHN, on *Haematoxylon* sp. *CHIAPAS*: 28 mi W Cintalapa, 9-IV-62, Parker & Stange [UCDC]. **(New state records)**

Chrysobothris azurea LeConte 1857:8. *MISSOURI*: Montgomery Co., Graham Cave State Park, 6-VI-75, R. Heitzman, on foliage *Fraxinus a. americana* L.

Chrysobothris bimarginicollis Schaeffer 1905:148. Reared from infested limbs of *Quercus arizonica* Sarg. and *Q. hypoleucoides* A. Camus, taken in *ARIZONA*: Chiricahua Mts., South Fork of Cave Creek, GHN, wood collected VIII-73, adults emerged VIII-74. (**New host records**)

Chrysobothris bispinosa Schaeffer 1909:376. One female reared from limb of *Quercus hypoleucoides* A. Camus in ARIZONA: Chiricahua Mts., South Fork of Cave Creek, GHN, wood collected VIII-73, emerged 22-II-74 **(New host record)**. MEXICO, *SONORA*: Nogales, 11-X-65, A. E. Michelbacher [GHNC]. *CHIHUAHUA*: 32 mi S Hidalgo de Parral, 21-VIII-60, D. C. Rentz [CASC]. **(New record, Mexico)**

Chrysobothris blanchardi Horn 1886:93. *MINNESOTA*: Koochiching Co., T71, R24, S35, 30-VII-59, R. T. Franklin [UGCA]. *NEBRASKA*: Dawes Co., Chadron, 5-VII-68, B. C. Ratcliffe [GHNC]. *ARIZONA*: Coconino Co., Oak Creek Can., Pine Flat Cpgnd., 17, 18-VI-75, F. T. Hovore [RLWE]. CANADA, *ONTARIO*: Lake Nipissing, Sandy Island, 15-VII-23, E. Walker [GHNC] (**New state and provincial records**). The occurrence of this insect in Arizona is very interesting, as the nearest recorded locality is Capitan, New Mexico, approximately 370 miles to the east-southeast. Elsewhere it seems to be found primarily in the northeastern states. This species has not been recorded from the Rocky Mountains, though undoubtedly it occurs there.

Chrysobothris debilis LeConte 1860 (1859):236. Chamberlin (1926) recorded this species from a number of southwestern states (some of which have been confirmed) but Fisher (1942) indicated that many of these records refer to *C. lateralis* and *C. rossi*. A confirming record for *UTAH*: Washington Co., St. George, collection of Vasco M. Tanner [BYUC]. *Acacia greggii* Gray is verified as a host in *CALIFORNIA*: Riverside Co., above Palm Desert, Hwy. 74, 2000 feet, wood collected 24-X-65, emerged 15-IV to 28-VI-66; and Imperial Co., Mountain Springs, 10 mi E Jacumba, wood collected 4-II-62, emerged 29-V to 11-VI-62, all GHN. Also reared from limbs *Salix* sp., *ARIZONA*: Yuma Co., 2 mi SW Yuma, W. H. Tyson [GHNC]. **(New host record)**

Chrysobothris dentipes (Germar) 1824:38. *NEBRASKA*: Thomas Co., Halsey, 25-VII-69, R. J. Leudtke [RLWE]. (**New state record**)

Chrysobothris humilis Horn 1886:99. MEXICO, *SONORA*: 47 mi N Hermosillo, 19-III-67, E. M. Fisher [RLWE]. (**New record, Mexico**)

Chrysobothris lateralis Waterhouse 1887:47. Previously reported from Arizona, New Mexico, Texas and Mexico. *CALIFORNIA*: San Bernardino Co., 12 mi NW Essex and Michell's Cavern, 16-VI-62, on *Acacia greggii* Gray, D. S. Verity & GHN; Providence Mts., Cedar Canyon, 17-VI-62, D. S. Verity (**New state record**). These have the typical features of *C. lateralis* except the abdominal sternites have faint lateral smooth callosities (supposedly characteristic of *C. debilis* but variable in both species).

Chrysobothris libonoti Horn 1886:104. Reared from limbs of *Quercus hypoleucoides* A. Camus and *Q. arizonica* Sarg., *ARIZONA*: Chiricahua Mts., South Fork of Cave Creek, GHN, wood collected VIII-73, adults emerged 17-XII-73 to 28-III-75. **(New host records)**

Chrysobothris nixa Horn 1886:85. One specimen reared from *Cupressus nevadensis* Abrams, *CALIFORNIA:* Kern Co., near Bodfish, Derham Giuliani [CASC] **(New host record)**. This beetle is known to breed in several other plants of the family Cupressaceae and likely will be found in any member of this family growing within its range.

Chrysobothris paratabalipa Nelson 1975:29. MEXICO, *JALISCO*: Puerto Vallarta, 9-XII-75, W. F. Barr, on *Acacia cockliacantha* Humb. & Bonpl. (**New state record**)

Chrysobothris rossi Van Dyke 1942:117. MEXICO, *NUEVO LEON:* 41 mi N Matehuala, Hwy. 57, 26-VI-65, GHN. **(New state record)**

Chrysobothris viridiceps Melsheimer 1845 (1844):147. *TENNESSEE*: Hardeman Co., VI-75, J. E. Wappes, emerged *Pinus* sp. [GHNC] (**New host and state record**). *OKLAHOMA*: Osage Co., 35 mi W Pawhuska, 26-VI-67, RLW. *NEW MEXICO*: Grant

Co., 20 mi SW Silver City, VIII-74, R. H. Turnbow, emerged *Quercus* sp.; Las Cruces, 13-V-75 [GHNC] (**New state records**). *TEXAS*: Hidalgo Co., Bentsen-Rio Grande St. Park, 19-VI to 5-VII-75, R. H. Turnbow, emerged *Prosopis* sp. [Turnbow Coll., RLWE]. (**New host record**)

Agrilus abductus Horn 1891:325. *MISSOURI:* Jackson Co., Lake Jacomo, 13-VI-69, on *Gleditsia triacanthos* L. Henry Co., 14 mi SE Clinton, 19-VI-75, on *Quercus* sp., all GHN (**New state record).** Also *TEXAS:* Brazos Co., 4-IV-59, H. R. Burke, on *Zanthoxylum clavaherculis* L. [GHNC]; College Station, 19-IV-64, S. G. Wellso, on *Quercus stellata* Wang. [SGWC, GHNC].

Agrilus abstersus Horn 1891:324. *ARIZONA:* Congress Junction, 26-VI-64, on *Acacia constricta* Benth.; Sixshooter Canyon, near Globe, 8-VI-63, on *Prosopis juliflora (SW) DC.;* Santa Catalina Mts., Sabino Canyon, 11-VIII-61, on *Celtis pallida* (Planch), all GHN.

Agrilus acaciae Fisher 1928:279. Previously known only from Texas. MEXICO, *SONORA*: 15 mi E Navojoa, 21-VIII-59, RLW. (**New record, Mexico**)

Agrilus amelanchieri Knull 1944:80. This species was described from Mont Alto, Pennsylvania. The following records indicate a range similar to *A. vittaticollis* (Randall), a species associated with the same plant genera. *OREGON*: Jackson Co., Siskiyou Pass, 8,22-VII-70, RLW, on *Amelanchier florida* Lindl. [RLWE, ODAC, GHNC, CHAH, FMNH, W. F. Barr]. Marion Co.: Salem Airport, 4-VII-74, RLW, on *Crataegus douglasii* Lindl.; Salem, Cascade Gateway Park, 12-VII-74, on *C. douglasii* and 13-VII-74, on *A. florida*, RLW. Umatilla Co., McKay Creek, NE 1/4 Section 23, T1N, R32E, 29-VI-71, on *Crataegus* sp., RLW. *UTAH*: Carbon Co., 5 mi NW Helper, 25-VI-72, on *Amelanchier* sp., RLW. *COLORADO*: Pitkin Co., Aspen, Red Butte, 25-VII-75, F. M. Beer, on *Amelanchier* sp. *NORTH DAKOTA*: Richland Co., 7-VII-64, Robert Gordon. *NEVADA*: Elko Co., Ruby Mts., Lamoille, 20-VI-60, F. M. & V. S. Beer [GHNC]. *CALIFORNIA*: Modoc Co., Howard Gulch Public Camp, 6 mi NW Canby, 2-VII-65, F. M. Beer, on *A. florida.* (**New state records**)

Agrilus angelicus Horn 1891:298. Previously known only from California, where it occurs practically throughout the range of its host plants, *Quercus* spp. Southwestern *OREGON*: Jackson Co., Siskiyou Pass, 8-VII-70, RLW, on *Quercus* sp. [RLWE, ODAC]; Josephine Co., 3 mi S Cave Jct., 6-VII-69, RLW. (**New state record**)

Agrilus anxius Gory 1841:226. *WASHINGTON*: Walla Walla, R. L. Penrose & R. L. Westcott, reared from ornamental birch collected 27-IV-72, adults emerged 27-V-72 [WSUC] (**New state record**). This species was reported from Oregon by RLW in the 1968 Coop. Econ. Ins. Rept., 11:948.

Agrilus arcuatus arcuatus (Say) 1825:251. *MISSOURI*: Henry Co., 14 mi SE Clinton, 28-VI-73 & 19-VI-75, GHN, on foliage *Quercus* sp. (**New state record**)

Agrilus arcuatus corylicola Fisher 1928:71. Specimens from *RHODE ISLAND*: Westerly, 11-20-VI-36, M. Chapman [GHNC]. (**New state record**)

Agrilus arcuatus torquatus LeConte 1860 (1859):243. *MISSOURI*: Henry Co., 14 mi SE Clinton, 28-VI-73 and 19-VI-75, GHN, on foliage of *Carya ovata* (Mill.) K. Koch. (**New state record**)

Agrilus arizonicus Obenberger 1936:139. This species has been recorded only from Arizona, where it has been collected in large numbers. MEXICO, *SINALOA*: 34 mi E Villa Union, 27-VIII-60, RLW. *MICHOACAN*: Patzcuaro, 2100 m., 27-VII-47, T. H. Hubbell [GHNC]; Cotija, 3-IX-70, B. Villegas [UCDC]. (**New record, Mexico)**

Agrilus aureus Chevrolat 1837:98. *TEXAS*: Chisos Mts. Basin: 24,27-VII-71, GHN; (4-6)-VII-61, 2-VII-72, RLW. Davis Mts., Hwy. 118, 20 mi S Kent, 29-VII-69, GHN; N of Ft. Davis, Limpia Cyn.: 30-VI-71, GHN, all on *Sphaeralcea* sp.; (17-20)-VI-61, RLW, sweeping roadside vegetation. MEXICO, *AGUASCALIENTES:* Pabellón, 26-VI-56, R. P. Allen [CDAE, RLWE]. (**New state records**)

Agrilus baboquivariae Fisher 1928:184. This species has been recorded from *Celtis pallida* Torr. by Knull (1944). *ARIZONA*: Pima Co., Box Canyon, 18-VII-75, W. H. Tyson, on *Bumelia* sp.

Agrilus benjamini Fisher 1928:107. *MISSOURI*, Jackson Co., VI-53, R. H. Pine [GHNC]. **(New state record)**

Agrilus blandus Horn 1891:321. Two specimens reared from *Eriogonum elongatum* Benth., *CALIFORNIA*: San Bernardino Mts., mouth of Deep Creek, S. of Hesperia, G. H. & K. T. Nelson, plants collected 13-V-62, adults emerged 30-VII-62; one specimen taken from its pupal cell, same host, Los Angeles Co., San Gabriel Dam, 1600′, 8-VIII-75, RLW **(New host record).** This species has been taken on *Eriogonum fasciculatum* Benth at numerous localities in southern California.

Agrilus cavatus Chevrolat 1838:99. MEXICO, *COLIMA*: 12 mi SW Colima, 1600′, 3-VIII-71, E. M. Fisher [RLWE]. *OAXACA*: Temescal, 5,6-VII-65, G. H. Nelson, on *Acacia* sp. **(New state records)**

Agrilus celti Knull 1920:11. *KENTUCKY*: Paducah, PJC Campus, 10-VI-68, Don R. Harris. *NEBRASKA*: Sarpy Co., Bellevue, 6-VI-64 [GHNC]. **(New State records)**

Agrilus cephalicus LeConte 1860 (1859):249. *MISSOURI*: Kansas City, 4-VI-67, GHN, on *Cornus* sp.; Cooper Co., 2 mi S Blackwater, 10-VI-69, RLW **(New state record)**. *MICHIGAN*: Washtenaw Co., Whitmore Lake, 9,10,17-VI-55, GHN, on *Cornus racemosa* Lam.

Agrilus chiricahuae Fisher 1928:243. Plant associated collections include *ARIZONA*: White Mts., S of McNary, 1-VII-64, 6 mi S Prescott, 29-VI-64, all on *Quercus utahensis* Ryd.; Huachuca Mts., Miller Canyon, 23-VIII-64 and Chiricahua Mts., 9 mi above Portal, 18,22-VII-75, all on *Q. hypoleucoides* A. Camus; 9 mi above Portal, 18-VII-75, on *Platanus wrightii* Wats., all collections GHN. Yavapai Co., Yarnell, 29-V-70, RLW, beating *Mimosa* sp.

Agrilus cliftoni Knull 1941:382. *MISSOURI*: Jackson Co., Raytown, 28-V to 1-VII-69, GHN, on *Juglans nigra* L.; Boone Co., Columbia, 10-VI-69, RLW. *GEORGIA*: Morgan Co., Hwy. 441, 6-V-73, R. H. Turnbow. **(New state records)**

Agrilus crataegi Frost 1912:247. on *Crataegus* sp.: *MISSOURI*: Jackson Co., Raytown, 4-VI-71; 5-VI-74; 10-VI-74 and Lee's Summit, 26-VI-74, all GHN; *INDIANA*: Tippecanoe Co., 5-VI-62; (8-10)-VI-64; (4-18)-VI-65, all N. M. Downie [RLWE, GHNC]; *NEW YORK*: Tompkins Co., 18-VI-65, N. M. Downie [RLWE] and Rossie, 15-VIII-56; 12-VI-64; 14-VI-65, all N. M. Downie [GHNC]. **(New state records)**

Agrilus crinicornis Horn 1891:294. *MISSOURI*: Jackson Co.: Lake Jacomo, 16-VI-69, GHN, on *Carya* sp.; Raytown, 4-VI-71, GHN, on *Juglans nigra* L. Boone Co., Columbia, 5-VII-66, C. W. Craig [RLWE]. **(New state record)**

Agrilus cupreonitens Fisher 1928:265. *TEXAS*: Lake Corpus Christi State Park, 7,8-IV-72, GHN, on *Acacia farnesiana* Willd.

Agrilus cyanescens (Ratzeburg) 1837:62. *NEW YORK*: Tompkins Co., Ithaca, 20-V, 8,9-VI-74, Tim L. McCabe [CUIC, RLWE]. **(New state record)**

Agrilus defectus LeConte 1860 (1859):244. *MARYLAND*: Howard Co., Ellicott City, 4-VI-68. *NORTH DAKOTA*: Cass Co., 12-VI-63; Grand Forks Co., Goose River, 22-VI-64; Richland Co., 7-VII-64, all Robert Gordon [RDGC, RLWE]. **(New state records)**

Agrilus diospyroides Knull 1942:390. *MARYLAND*: Prince Georges Co., Greenbelt, 8-VI-68, H. L. Dozier, on *Diospyros virginiana* L. [BKDC, GHNC]. **(New state record)**

Agrilus duncani Knull 1929. Ent. News 40:270. (*Agrilus nodicornis* Fall 1932. Pan-Pacific Ent. 8(2):82. **New synonym**). An examination of the unique male type reveals that it is an example of *A. duncani* with a deformity of the antennae in which segments 5 and 6 are fused. In the original description the collection date was recorded as 2-VII-24. The label on the type reads 12-VII-24.

Agrilus egeniformis Champlain & Knull 1923:84. *TENNESSEE*: Reelfoot Lake, 2-VI-54, D. J. & J. N. Knull [RLWE, FMNH] **(New state record).** This species is usually collected on *Gleditsia triacanthos* L., but a series was taken on *Sapindus drummondii* Hook & Arn., *KANSAS*: Barber Co.: Medicine Lodge, 2-VI-75; 7 & 8 mi W Medicine Lodge, 2,3-VI-75, all GHN, J. R. Heitzman; 5 mi W Medicine Lodge, 20,21-VI-75, GHN.

Agrilus exhuachucae Knull 1937:305. *ARIZONA*: Huachuca Mts., Miller Canyon, 19-VII-69, G. H. & D. E. Nelson, on *Quercus hypoleucoides* A. Camus [GHNC]; Cochise Co., 6 mi E Pierce, 8-VIII-73, GHN, sweeping roadside vegetation.

Agrilus fallax Say 1839 (1836):163. *NEBRASKA:* Sarpy Co., Fontanelle Forest, 11-VII-69, B. C. Ratcliffe [GHNC]. **(New state record)**

Agrilus ferrisi Dury 1908:368. *MISSOURI*: Kansas City, Swope Park, 15-VII-70; Henry Co., 14 mi SE Clinton, 1-VII-73, on *Celtis occidentalis* L., GHN. **(New state record)**

Agrilus fisherianus Knull 1930:3. Specimens of this species, described from a unique from Phoenix, Arizona, have been taken as follows. *NEW MEXICO*: San Marcial, 20-VII-61, J. G. Watts [GHNC]. *CALIFORNIA*: Needles, 11-VI-40, K. S. Hagen, all on *Salix* sp. **(New state records)**

Agrilus frosti Knull 1920:8. *MISSOURI*: Webster Co., 5 mi E Seymour, 26-IV-72 [GHNC]. **(New state record)**

Agrilus fuscipennis Gory 1841:238. Collected on *Diospyros virginiana* L., *MISSOURI*: Henry Co., 7 mi E Clinton, 17,20-VI-73, GHN; 14 mi E Clinton, 28-VI-73, GHN & M. Masters [RLWE]. **(New state record)**

Agrilus geminatus (Say) 1823:163. *MINNESOTA*: Houston Co., Mississippi Bluff, 1-2 mi N State Line, 1-VI-51; Winnebago Cr. Vy., 3-4 mi NE Eitzen, 2-VI-75 [DEFW]. *GEORGIA*: Clarke Co., Whitehall Forest, 7-VI-72, R. H. Turnbow. **(New state records)**

Agrilus gibbicollis Fall 1901:241. This species is recorded from practically throughout the southwestern United States and in Wyoming. *NEVADA*: Clark Co., Spring Mts., Kyle Canyon, 29-VII-61, RLW; Lincoln Co., Caliente, 14-VII-58, F. D. Parker [NSDA] **(New state record)**. Specimens were taken by RLW on *Gutierrezia* spp., which undoubtedly are its hosts, in SE Utah and SW California.

Agrilus granulatus granulatus (Say) 1823:162. *MINNESOTA*: Itasca State Park, 1-VII-58, L. R. Abra [DEFW]. **(New state record)**

Agrilus granulatus liragus Barter & Brown 1949:247. A single specimen was taken from its pupal cell in *Populus tremuloides* Michx. in *CALIFORNIA*: Modoc Co., Hilton Spike, 30-VI-65, R. L. Penrose [RLWE]. Also *NEVADA*: Elko Co., Ruby Mts., Angel Lake Camp, 7000′, 15, 19-VII-75, Ray Albright, J. H. Baker, on *P. tremuloides* Michx. [Albright Coll., JHBC, RLWE, GHNC] **(New state records)**. This species, the hosts of which are *Populus* spp., often is confused in collections with the birch-feeder, *A. anxius* Gory. The known ranges of the 2 are quite similar, but the latter is not recorded from California or Nevada.

Agrilus granulatus mojavei Knull 1952, Ohio J. Sci., 52(6):352. **(New status)**. When Carlson and Knight (1969) considered *A. g. granulatus* (Say) and its subspecies they did not consider *A. mojavei* Knull. The latter form is closely similar to *A. g. populi* Fisher, as pointed out by Nelson (1965), but is more uniformly brassy-cupreous in color and more densely pubescent ventrally. It appears, however, that *A. g. mojavei* is not specifically different from *A. g. granulatus* and its other subspecies and represents a southwestward extension, being found in southern California on *Populus fremontii* Wats.

Agrilus heterothecae Knull 1972:299. This species was previously recorded as *A. huachucae* Schaeffer (Nelson 1965).

Agrilus huachucae Schaeffer 1905:150. Previously recorded only from S. Arizona. *NEW MEXICO*: Catron Co., Gila Nat'l. Forest, Whitewater Public Camp, 11 to 14-VII-70, J. A. Gruwell [RLWE]. **(New state record)**

Agrilus illectus Fall 1901:242. OREGON, Malheur Co., Basque Station, Hwy. 95, 3-VII-74, K. J. Goeden, on shadscale, *Atriplex confertifolia* (Torr.) Wats. [ODAC] **(New State record).** New plant records for adults from *CALIFORNIA*: San Diego Co., Oak Grove, 24-VI-62, GHN, on *Lotus scoparius* (Nutt.) Ottley; Los Angeles Co., San Gabriel Mts. along Throop Peak Trail, 8100′, near Dawson Saddle, 28-VI, 8-VII-75, RLW, on *Eriogonum umbellatum aridum* (Greene) S. Stokes.

Agrilus imbellis Crotch 1873:94. When Fisher (1928) compared this species with *A. lacustris* LeConte the records indicated *A. imbellis* to be confined to the Atlantic States, from Massachusetts to Florida, and *A. lacustris* to the Middle West, from Lake Superior to Texas and westward to southern California. The range of *A. imbellis* is more extensive than was believed by Fisher, with new records as follows. *MISSISSIPPI*: Greenville, 16-VIII-45, A. G. Peterson [DEFW]. *MICHIGAN*: Livingston Co., E. S. George Reserve, 12-VII-53, GHN. *MINNESOTA*: Anoka Co., St. Paul Water Works, 20-VII-51 [DEFW] **(New state records).** Chamberlin (1926) included Texas in the distributional range for this species, but Fisher (1928) felt that this probably was based on misidentified specimen(s) of *A. lacustris* LeConte. However, the following records confirm the occurrence of *A. imbellis* in TEXAS: Burnet Co., Inks Lake St. Park, 18-IV-62, T. M. Peters, F. W. Stehr [DEFW]; Brazos Co., 1 mi W College Station, 16-V-64, S. G. Wellso, on *Bigelovia virgata* (Nutt.) DC. [SGWC, GHNC].

Agrilus juglandis Knull 1920:7. Reared from *Juglans*?, *MARYLAND*: Takoma Park, emerged 18-II-51, D. G. Kissinger [GHNC]. **(New state record)**

Agrilus lacustris LeConte 1860 (1859):250. MEXICO, *SONORA*: Navojoa, 13-VII-58, RLW. *SINALOA*: 20 mi SE El Fuerte, 12-VII-62, E. L. Sleeper [CSLB]. **(New state records)**

Agrilus lecontei lecontei Saunders 1871:117. *NEBRASKA*: Sarpy Co., Fontanelle Forest, 11-VII-69, B. C. Ratcliffe [GHNC]. **(New state record)**

Agrilus secontei celticola Fisher 1928:294. *NEW MEXICO*: Chavez Co., 8 mi E Elk, Hwy. 83, 11-VII-63, GHN, on *Celtis* sp. *KANSAS*: Barber Co., 7 & 8 mi W Medicine Lodge, 2,21-VI-75, GHN & J. R. Heitzman, all on *Celtis laevigata* var. *texana* Sarg. *OKLAHOMA*: Oklahoma City, 6-VI-71, GHN, on same plant. **(New state records)**

Agrilus limpiae Knull 1941:283. *KANSAS*: Barber Co., 8 mi W Medicine Lodge, Red Hills, 2-VI-74, J. R. Heitzman [GHNC], 2-VI-75, GHN & J. R. Heitzman and 5 mi W Medicine Lodge, 21-VI-75, GHN, all on *Sapindus drummondii* Hook. & Arn. **(New state record)**

Agrilus malvastri Fisher 1928:247. This species has been collected in Texas, New Mexico, and Arizona on *Sphaeralcea* spp., GHN.

Agrilus masculinus Horn 1891:295. *NEBRASKA*: Sarpy Co., Bellevue, 29-V-64, on *Acer* sp. [GHNC]. *NORTH DAKOTA*: Bottineau Co., 23-VI-62; Cass Co., 12-VI-63; Grand Forks Co., Goose River, 15-VI-64; Richland Co., 17-VI-64, all Robert Gordon [RDGC, RLWE]; Ward Co., 6-VI-58, Edw. Saugstad [RDGC]. *MINNESOTA*: Pipestone Co., Pipestone Nat. Mon., 5-VII-73, malaise trap [DEFW]. **(New state records)**

Agrilus oblongus Fisher 1928:333. *GEORGIA*: Clarke Co., Whitehall Forest, 11-V-75, R. H. Turnbow. **(New state record)**

Agrilus obsoletoguttatus Gory 1841:256. *NEBRASKA*: Sarpy Co., Fontanelle Forest, 10-VI-69, B. C. Ratcliff [GHNC]. *MINNESOTA*: Anoka Co., Carlos Avery Wildlife Ref., 24-VI-71, B. Cutler; Houston Co., Winnebago Cr. Vy., 3-4 mi NE Eitzen, 29-V-49; S Minneiska, John Latsch St. Pk. [DEFW]. **(New state records)**

Agrilus olentangyi Champlain & Knull 1925:469. *MISSOURI*: Jackson Co.: Raytown, 4-VI-71, on *Quercus* sp., 28-V-69, on *Celtis occidentalis* L. Lake Jacomo, 16-VI-69, all GHN. **(New state record)**

Agrilus ornatulus Horn 1891:319. *KANSAS*: Barber Co., 5 mi W Medicine Lodge, 21-VI-75, GHN, on foliage of young *Sapindus drummondii* Hook. & Arn. **(New state record)**

Agrilus osburni Knull 1937:38. *GEORGIA*: Clarke Co., Whitehall Forest, 1-15-V-75, R. Turnbow. **(New state record)**

Agrilus parabductus Knull 1954:28. *TEXAS*: Starr Co., 9-IV-63, D. J. & J. N. Knull, on *Acacia* sp. [FMNH, GHNC].

Agrilus paracelti Knull 1972:113. *KANSAS*: Barber Co., 7 mi W Medicine Lodge, 2-VI-75, GHN & J. R. Heitzman, and 8 mi W Medicine Lodge, 21-VI-75, GHN, all on *Celtis laeviata* var. *texana* Sarg. *OKLAHOMA*: Oklahoma City, 6-VI-71, GHN, on same plant. *GEORGIA*: Clarke Co., Whitehall Forest, 22-V-72, R. H. Turnbow. *MISSOURI*: Jackson Co., Raytown, 28-V, 7-VI-69, GHN, on *Celtis occidentalis* L. *NEBRASKA*: Sarpy Co.: Fontanelle Forest, 11-VII-69; Bellevue, 28-VI-69, both B. C. Ratcliffe [GHNC]. (**New state records**)

Agrilus paramasculinus Champlain & Knull 1923:274. *MISSOURI*: Clay Co., Coolie Lake, 10-V-75, GHN, on foliage of *Gymnocladus dioica* (L.) K. Koch. **(New state record).** *KANSAS*: Geary Co., Konza Prairie Reserve, 14 mi E Junction City, H. A. Hespenheide, reared from branches *Gymnocladus dioicus* (L.) K. Koch collected 11-III-74, adults emerged beginning 3-IV and thereafter -74. (**New host record**)

Agrilus parapubescens Knull 1934:68. When this species was described, nothing was known of its habits. *ARIZONA:* Portal, 11-VI-63; E of Globe, Gilson Butte, 8-VI-63, all on *Acacia greggii* Gray; Sixshooter Canyon, near Globe, 9-VI-63, on *Prosopis juliflora* (Swartz) DC., all GHN.

Agrilus parkeri Knull 1935:189. Previously recorded as reared from black oak slash (Knull 1937). Emerged from limbs of *Quercus arizonica* Sarg., *Q. emoryi* Torr., and *Q. hypoleucoides* A. Camus, all from *ARIZONA*: Chiricahua Mts., South Fork of Cave Creek, wood collected VIII-73, adults emerged 10-XI-73 to 10-II-74, GHN. (**New host records**)

Agrilus pseudofallax Frost 1923:279. *MISSOURI*: Jackson Co.: Lake Jacomo, 13, 16-VI-69; Raytown, 25-V-69, 5-V-70; Sugar Creek, 6-VI-75, all GHN, on *Gleditsia triacanthos* L. (**New state record**)

Agrilus pubifrons Fisher 1928:237. *CALIFORNIA*: Mono Co.: L. Big Rock Cr. P. C., 7500′, 27-VI-68, E. L. Sleeper [CSLB]; Rock Creek, 6300′, 25-VIII-72, Derham Giuliana, on *Chrysothamnus* sp. [CASC]. **(New state record)**

Agrilus pulchellus Bland 1865:382. *UTAH*: Cache Co., Logan, 4-VIII-65, R. M. Bohart [UCDC]; Cornish, 12-VII-71, E. Grisell, R. M. Bohart [UCDC, RLWE], 18, 20-VII-59, 17-VIII-62, 10-VII & 10-IX-63, VIII-68, G. Bohart, R. Brumley, P. Torchio [EMUS, RLWE]. *NORTH DAKOTA*: Richland Co., 27-VII-62, Robert Gordon (**New state records**). The latter represents the northernmost record for this species, the nearest recorded localities being in northern Utah and southeastern Kansas. *A. pulchellus* thus appears to be widespread in the Plains and Mountain States, ranging south into Mexico.

Agrilus pusillus (Say) 1825:252. *NORTH DAKOTA*: Richland Co., 1-VII-64, Robert Gordon (**New state record**). Fisher (1928) lists this species from South Dakota with “no definite locality”. A confirming record is *SOUTH DAKOTA*: Oglala, White River, 21-VI-66, Robert Gordon.

Agrilus quadriguttatus quadriguttatus Gory 1841:228. *MISSOURI*: McBaine, 16-VI-49, G. W. Thomas [GHNC]. *INDIANA*: Lafayette, 16-VII-56, GHN, on *Salix* sp. *NEBRASKA*: Lancaster Co., Hickman, 23-VI-69, R. J. Leudtke [RLWE]. (**New state records**)

Agrilus quadriguttatus fulminans Fisher 1928:148. *NEVADA*: Washoe Co., Verdi, 26-VI-62, RLW. (**New state record**)

Agrilus quercicola Fisher 1928:120. Known previously from Colorado, Arizona, New Mexico, and Utah. *TEXAS*: Davis Mts., 19-VI-58, D. J. & J. N. Knull [FMNH, GHNC]; Davis Mts., Limpia Canyon, 17/20-VI-61, RLW. (**New state record**)

Agrilus quercus Schaeffer 1905:150. *ARIZONA*: Huachuca Mts., Miller Canyon, 23-VIII-64; Santa Rita Mts., Madera Canyon, 14-VIII-65, both *Quercus arizonica* Sarg.; Madera Canyon, 3-VIII-74, on *Q. hypoleucoides* A. Camus, all GHN.

Agrilus rubrovittatus (Waterhouse) 1889:50. In general appearance specimens are similar to *A. pulchellus* Bland; however, in the latter the lateral impressions of the pronotum are strong and the dense pubescence of the abdominal sternites is lacking along the posterior margins and posterolateral angles, whereas in *A. rubrovittatus* the pronotum is more evenly convex and the dense pubescence of the abdominal sternites is rather evenly distributed. This species was previously known only from Mexico. *COLIMA*: Armeria, 27-VII-63, RLW; 13 mi NW Manzanillo, 25-VII-66, D. S. Verity, on *Boerhaavia erecta* L. [Verity Coll., RLWE]. *GUERRERO:* 3 mi N Chilpancingo, 17-VIII-70, E. M. Fisher [RLWE] (**New state records**). *ARIZONA*:

Huachuca Mts., Miller Canyon, 19-VII-63, G. H. & D. E. Nelson, sweeping grass; Chiricahua Mts., 9 mi above Portal, 31-VII-75, all GHN, on bunch grass, *Muhlenbergia longiligula* Hichc. (**New record, USA**). In the specimens from Colima the cupreous vitta does not extend to the apex of each elytron as it does in specimens from Arizona.

Agrilus sapindi Knull 1938:139. Described from 2 males from Texas, Davis Mts. *KANSAS*: Barber Co., 5 mi W Medicine Lodge, 2-VI-75, GHN & J. R. Heitzman, and 21-VI-75, GHN, all on foliage of very young *Sapindus drummondii* Hook, & Arn. **(New state record).** *TEXAS*: Frio Co., Jct. Hwy. 140 & Frio River, W of Pearsall, 9-VII-75, GHN & G. V. Manley.

PLESIALLOTYPE FEMALE, with foregoing Texas data. Closely similar to male but differs as follows: slightly more robust; front of head and elytra green, vertex of head, pronotum & ventral surface aeneous with green tints; tibiae lacking mucrones. Length 8.5 mm; width 2.7 mm. In the series at hand both sexes vary from rather uniform green to green with aeneous tints. The males vary in length from 8.2 to 9.5 mm, in width from 2.5 to 3.0 mm; the females 8.5 to 10.0 mm in length and 2.7 to 3.5 mm in width.

Agrilus scitulus Horn 1891:318. *KANSAS*: Barber Co.: 8 mi W Medicine Lodge, 2-VI-75, GHN & J. R. Heitzman; 5 mi W Medicine Lodge, 21-VI-75, GHN, all on the foliage of young *Sapindus drummondii* Hook. & Arn. (**New state record**). *TEXAS*: Lake Corpus Christi State Park, 7-VI-54, H. F. Howden, on *Carya pecan* Engelm. & Graebn. [HAHC, GHNC].

Agrilus subcinctus Gory 1841:252. *KANSAS*: Barber Co., 8 mi W Medicine Lodge, 2-VI-75, GHN & J. R. Heitzman, on *Fraxinus* sp. *NEBRASKA*: Lancaster Co., Hickman, 19-VI-69, B. C. Ratcliffe [GHNC]. (**New state records**)

Agrilus townsendi Fall 1907:234. Adults were reported from *Quercus utahensis* (Cand.) Rydb. by Fisher (1928). One male was taken on *Q. hypoleucoides* A. Camus, *ARIZONA*: Chiricahua Mts., 6 mi above SW Res. Sta., 24-VII-69, GHN.

Agrilus transimpressus Fall 1925:181. *MISSOURI:* Jackson Co., Raytown, 28-V-69; Lake Jacomo, 16-VI-69, all GHN, on *Juglans nigra* L. *MINNESOTA:* Houston Co., Mississippi Bluff, 1-2 mi N State Line, 1-VI-51, 22-V-48, 27-V-55, B. Furgola [DEFW, RLWE]. **(New state records)**

Agrilus ventralis Horn 1891:320. This odd and rarely collected species has been recorded from New Mexico, Arizona and California. *NEVADA*: White Pine Co., Lehman Caves, 9-VII-66, R. P. Allen [CDAE]; Clark Co., Spring Mts., Kyle Canyon, 18-VII-70, B. W. Miller, on *Chrysothamnus* sp. [B. W. Miller Collection, WFBC] (**New state record**). A small series was swept from foliage of *Encelia virginensis actoni* (Elmer) Keck, *CALIFORNIA*: Inyo Co., .3 mi E Independence, 26-V-74, RLW. *E. v. actoni* probably serves as a larval host for this beetle; other genera and species of Compositae possibly serve as hosts elsewhere in its range.

Agrilus vittaticollis Randall 1838:38. *MONTANA*: Sanders Co., Plains and 13 mi NE St. Regis, Loren Russel. *UTAH*: Carbon Co., 15 mi NW Price, 6800′, 25-VI-72, *Amelanchier* sp., RLW. *NORTH DAKOTA*: Pembina Co., 12-VII-62, Robert Gordon **(New state records).** This species heretofore has been recorded from Maine to Florida, westward to Washington and N. California, though not from a number of states between. However, it probably occurs throughout the range of its primary host plants, *Crataegus* spp. and *Amelanchier* spp. It is not often collected in large numbers but W. F. Barr and RLW took upwards of 100 specimens on *Crataegus douglasii* Lindl. during VII-74, in *OREGON*: Marion Co., Salem.

Pachyschelus purpureus (Say) 1839 (1836):164. *ALABAMA*: Madison Co., Huntsville, 11-IX-74, Lester L. Lampert [RLWE]. (**New state record**)

Brachys aerosus Melsheimer 1845:148. *NEBRASKA*: Sarpy Co., Fontanelle Forest, 10-VI-69, B. C. Ratcliffe, on *Quercus* sp. [GHNC]. *NORTH DAKOTA*: 10 mi W Cavalier, 7-VII-66; Bottineau Co., 12-VII-62, 9-VII-64; Eddy Co., 5-VI-63, all Robert Gordon; Cass Co., 20-VI-61, Robert Tetrault [RDGC]; Slope Co., Chalky Buttes, 7-VI-65, L. Grochowski [RLWE]. (**New state records**)

Brachys aeruginosus Gory 1841:335. *MISSOURI*: Henry Co., 14 mi SE Clinton, 16-VI-74, GHN, on *Quercus alba* L.; Boone Co., Columbia, 10-VI-69; Cooper Co., 2 mi S Blackwater, 10-VI-69, both RLW. **(New state record)**

Brachys ovatus (Weber) 1801:76. *NEBRASKA*: Sarpy Co., Bellevue, 28-VI-69, B. C. Ratcliffe [GHNC]. **(New state record)**

Taphrocerus agriloides Crotch 1873:75. *NORTH CAROLINA*: Bell Island, 10-V-52, GHN. *MISSOURI*: Brunswick, 26-V-71, W. S. Craig [GHNC]. **(New state records)**

Taphrocerus albonotatus Blatchley 1919:29. *NEW JERSEY*: Ocean Co., Bamber, 2-VII-66, L. L. Pechuman [CUIC, GHNC, RLWE]. **(New state record)**

Taphrocerus howardi Obenberger 1934:42. Collected in malaise trap, *MISSOURI*: Holt Co., Mound City, 6-IX to 7-X-68 [GHNC]. **(New state record)**

Taphrocerus laevicollis LeConte 1878:403. *MISSISSIPPI*: Pascagoula, 16-V-60, B. K. Dozier [BKDC, RLWE]. **(New state record)**

Taphrocerus schaefferi Nicolay & Weiss 1920:144. *MICHIGAN*: Ann Arbor, 19-VI-53, GHN; Lenawee Co., Morenci, 1-VI-74, S. G. Wellso [RLWE]. *INDIANA*: Indianapolis, 12-VI-44, E. L. Mockford. *MARYLAND*: 6 mi S Plum Point, 24-V-53, GHN. *MISSOURI*: Holt Co., Mound City, 6-25-IX-68, Malaise trap, all [GHNC]. **(New state records)**

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NEW DISTRIBUTION RECORDS OF CHRYSOMELINAE (COLEOPTERA: CHRYSOMELIDAE)[1]

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ABSTRACT

Information on the distribution of 31 species and subspecies of Chrysomelinae is provided. Most of these are from Wyoming but several entries not previously published from other areas are included.

During preparation of the section on Chrysomelinae for the North American Beetle Fauna Project, it became apparent that many specimens on hand represented records not included in the red version of the Checklist for Chrysomelidae (Wilcox 1975). This material is in the Entomology collection, University of Wyoming, and in the writer's personal collection. Multiple entries for more common species are included to show seasonal distribution, geographic range, and time of occurrence in different years. Most are previously unpublished Wyoming records, with a few new records from other states also included.

The collector name from specimen data, when available, is indicated by initials to save space and avoid repetition. The persons so indicated are as follows: GDB—G. D. Beierle; C. B.—C. Brown; RPB—R. P. Burton; CLC—C. L. Corkins; AGD—A. G. Davison; GRD—G. R. DeFoliart; DGD—D. G. Denning; WDF—W. D. Fronk; LDH—L. D. Hale; CPH—C. P. Hartley; DH—Dale Hawes; JRH—J. R. Howell; JGJ—J. G. Johnston; BSK—B. S. Kimball; WK—W. Knaus; JBK—J. B. Kring; RJL—R. J. Lavigne; FAL—Fred A. Lawson; WDM—W. D. Marks; NLM—N. L. Marston; MM—Mark Mason; CEM—C. E. Melvin; RLP—R. L. Parker; AEP—A. E. Parshall; REP—Pfadt; KSP—K. S. Pike; CR—C. Ritter; ACS—A. C. Scoggan; KLS—K. L. Sherwin; ES—E. Spackman; JHT—J. H. Tully; DMT—D. M. Tyndall; TSW—T. Winburn; CBW—C. Barry Wingfield.

Many of the specimens reported here were identified by John A. Wilcox, a few by M. W. Sanderson, and the remainder by the writer, using keys by Wilcox (1972), Brown (1942, 1945, 1951, 1956, 1962), Blatchley (1910), and Linell (1896). Original descriptions and previously identified material were also consulted.

Calligrapha amator Brown. WYOMING: Park Co., 6-VII-67 FAL.

Calligrapha californica coreopsivora Brown. WYOMING: Goshen Co., 10-VI-49 DGD; Pine Bluffs, 30-V-55 REP. MICHIGAN: Big Stone Bay, 21-VII-24. NEW YORK (no other data).

Calligrapha lunata (Fab.). WYOMING: Crook Co., 14-VI-38.

Calligrapha multipunctata (Say). WYOMING: Laramie, 6-VIII-63 DH; 15-VII-63 RPB; Platte Co., 23-VIII-66 ACS, FAL. KANSAS: Manhattan, 17-IV-50 JBK.

Calligrapha multipunctata bigsbyana (Kirby). CANADA: Trinity Valley, BC 12-VI-29 JRH.

Calligrapha philadelphica (Linn.). CANADA: Trinity Valley, BC 12-VI-29 JRH.

Calligrapha pnirsa (Stal). CANADA: Montreal Isl., QU 16-IX---

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Calligrapha sigmoidea (LeConte). CANADA: Trinity Valley, BC-8-VIII-29 JRH.

Calligrapha verrucosa (Suffr.). WYOMING: Laramie, 19-V-1894; 20-V-1894; 15-VIII-63 GDB; Albany Co., 19-VIII-70 FAL (on *Salix*); 15-VIII-74 FAL (on *Salix*); 20-VI-75 FAL (on *Salix*); 10-VII-75 FAL (on *Salix*).

Chrysolina auripennis (Say). WYOMING: Guernsey, 19-V-63; 20-V-63.

Chrysolina flavomarginata (Say). WYOMING: Johnson Co., 22-VI-37; Niobrara Co., 8-VII-43 REP; Platte Co., 14-VII-50 REP; Wheatland, 24-VI-50; Guernsey, 12-VII-51; Laramie, 6-VI-61; Wheatland, 8-VII-62 RJL (on *Artemisia*); Platte Co., 30-VI-73 FAL (on "snakeweed"). NEW MEXICO: Cloudcroft, 6-VIII-1902.

Chrysomela aeneicollis (Scheaffer). WYOMING: Teton Co., 11-VIII-71 KSP.

Chrysomela crotchi Brown. NEW YORK (no other data).

Chrysomela invicta Brown. CANADA: Proctor, AB 24-V-28.

Chrysomela knabi Brown. WYOMING: Greybull, 2-VI-65 RJL; Powell, (no other data); Albany Co., 12-VIII-38; Wheatland, 25-VI-52 GRD; Fremont Co., 5-VII-68; Lincoln Co., 11-VIII-71 KSP. KANSAS: Wathena, 28-IV-27 RLP; Riley Co., 10-VI-54 FAL; Pottawatomie Co., 6-IV-59 FAL. COLORADO: Fort Collins, 29-IX-56.

Chrysomela lineatopunctata (Forst.). WYOMING: Evanston, 16-VI-59 WDF; Platte Co., 5-VII-67 NLM; Fremont Co., 5-VII-68 FAL; Big Horn Co., 5-VI-75 FAL, ES; Park Co., 5-VI-75 FAL, ES; Big Horn Co., 13-VII-75 JGJ.

Chrysomela scripta Fab. WYOMING: Chugwater, (no other data); Laramie, 17-VIII-55 WDF; 29-VII-74 FAL, ES; 25-VII-75 FAL, ES; Greybull, 2-VI-65 RJL; Albin, 13-VI-66 AEP; Pine Bluffs, 8-VII-67; Crook Co., 7-VII-70 AEP; Platte Co., 24-VI-72 FAL; 20-VI-75 FAL, ES; 18-VII-75 FAL, MM. COLORADO: Rocky Ford, 7-VIII-1899; Fort Collins, 2-X-56.

Entomoscelis americana Brown. WYOMING: Laramie, (no other data). COLORADO: Pingree Park, 10-VIII-.

Gastrophysa cyanea Melsh. WYOMING: Laramie, 18-VII-1892; Carbon Co., 1-VIII-25 CLC; Big Horn Co., 17-VI-71 FAL; Baggs, 8-VI-70 AEP; Carbon Co., 28-VII-75 FAL; Basin, 7-V-69 AEP.

Gastrophysa formosa (Say). WYOMING: Albin, 15-VI-69 AEP; Platte Co., 8-VI-66 FAL; Glendo 23-IV-57 REP; LaGrange, 13-V-69 AEP; Torrington, 20-VI-75 FAL, ES.

Gastrophysa polygoni (Linn.). WYOMING: Torrington, 4-VII-52; Glendo, VII-53 CB; Douglas, 19-VI-69 AEP; Torrington, 5-VI-74 FAL; 20-VI-75 FAL. MICHIGAN: "Ag. Coll. Mich." 11-VI-1890. IOWA: Ames (no other data).

Gonioctena americana (Scheaffer). WYOMING: Albany Co., 4-VII-59 RJL; 16-VI-74 MM; 28-VI-74 FAL, MM; 20-VI-75 FAL.

Gonioctena notmani (Scheaffer). WYOMING: Albany Co., 26-VI-48 DGD; 4-VII-49 DGD.

Labidomera clivicollis (Kirby). WYOMING: Laramie, 10-X-35 CR. KANSAS: Medora, 20-VII-29 WK; Medora, 9-VIII-29 WK.

Leptinotarsa decemlineata (Say). WYOMING: Dwyer, 10-VII-24 CLC; Ralston, 5-VII-59 AGD; Goshen Co., 4-VIII-66 WDM; 15-VI-70 FAL; Torrington, 18-VII-75 FAL, MM; Shell Canyon 5-VI-69 AEP.

Phaedon viridis (Melsh.). WYOMING: Platte Co., 10-VI-75 FAL, ES. COLORADO: Fort Collins, 30-V-67 NLM.

Phratora frosti remissa Brown. WYOMING: Albany Co., 23-VI-70 FAL; 19-VII-70 FAL; 28-VI-74 FAL, MM; 23-VII-74 FAL.

Timarcha cerdo Stål. IDAHO: Fraser, -VIII- CPH.

Zygogramma conjuncta (Rogers) WYOMING: Laramie, 10-VI, 20-VII-1893; 20-VI-61 GDB; 27-VI-56 DMT; Big Horn, 3-VII-66, CBW; Torrington, 16-VII-69 AEP; Platte Co., 15-VIII-67 ACS. COLORADO: Fort Collins, 30-V-47 NLM.

Zygogramma conjuncta pallida (Bland) WYOMING: Goshen Co., 23-VII-44 REP; 18-VII-45 REP; 2-X-45 REP; Washakie Co., 10-VII-50 JHT; Worland, 23-VII-68 AEP; 7-V-69 AEP; 1-V-70 AEP; 4-VIII-70 AEP.

Zygogramma exclamationis (Fabr.) WYOMING: Platte Co., 15-VI-51 REP; 24-VI-72 FAL; Wheatland, 24-VII-51 REP; Glendo, 17-VII-59 REP; Lingle, 16-VII-63 REP (on sunflower); 20-VI-63 KLS; Pine Bluffs, 26-VI-68 AEP; Albin, 25-VI-68 AEP; Goshen Co., 15-VI-70 AEP; 30-VI-71 FAL; 16-V-44 REP; Converse Co., 16-VI-70 AEP; Wheatland, 18-VII-75 FAL, MM (on sunflower).

Zygogramma heterothecae Linell WYOMING: Albany Co., 27-VI-74 FAL. KANSAS: Rago (no other data).

Zygogramma suturalis casta (Rogers) WYOMING: Wheatland, 22-IX-56; Goshen Co., 5-VIII-70. COLORADO:-VII-BSK. KANSAS: Manhattan 28-VII-29 TSW; 24-VII-30 RLP.

DISCUSSION

The data given above provide highly useful (sometimes critical) information for prospective collectors of Chrysomelidae in Wyoming. Since the entire state is subject to rigorous climatic conditions, the season for many species (in some already very short) may be advanced or delayed by as much as 3 weeks. Long season species, commonly occurring at lower altitudes in the state, usually can be taken even though such a shift may have occurred. Species living at higher altitudes or having only a brief active period, frequently are missed completely when a weather-induced modification of the season has taken place.

For example, a cottonwood leaf beetle, *Chrysomela scripta*, occurs from early June through July and into August at lower altitudes in eastern Wyoming. In Laramie, the same species appears only in mid-July and has a single generation. Another cottonwood leaf beetle, *Chrysomela lineatopunctata*, appears briefly for 1 generation in northwest Wyoming; all attempts to obtain a second generation failed. The latter would be missed by a collector taking the usual August tourist approach.

An aspen leaf beetle, *Gonioctena americana*, occurs at 8,200 ft in the Sherman Mountains east of Laramie. These beetles normally appear in mid-June, produce one generation, then disappear into the surface litter beneath the trees. This beetle would likewise be missed unless rather specific timing and location were observed.

The small dock beetle, *Gastrophysa cyanea*, emerges in late May or early June in eastern and northern Wyoming. At Laramie (7,250 ft.) it appears at the end of June. About 60 miles northwest, in the Medicine Bow National Forest, a colony of these beetles, along the Medicine Bow River at 8,500 ft., becomes active in mid-July. In all localities the beetles produce only 1 generation, with new adults out briefly on the host plants. New adults from all locations listed above have been caged in the laboratory at the University of Wyoming and fed fresh young host plant material; up to 4 additional generations have been produced in this manner. However, larvae reared thus in August and September and placed on naturally aged, outdoor grown host plant material, fed only briefly and died; adults on the same material quickly became inactive. Similar experiments with *C. lineatopunctata* and *G. americana* were total failures.

The range of several "northern" species is extended south through Wyoming and into northern Colorado. These beetles occur at higher elevation in the Rocky Mountains, apparently coming in from the northwest and moving to the south and southeast. These beetles, also, are easily missed because the season at higher elevations is short at best and may be curtailed even more by inclement weather.

It is hoped, therefore, that the prospective collector of Chrysomelidae in Wyoming will benefit from the above information, particularly if his time here is short. Because of the limited occurrence of many species, it is suggested that a visiting specialist consult the list for the desired species, select 1 or 2 localities for intensive collecting, and plan to be in the field at definite times.

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CERAMBYCID BEETLES CAPTURED IN STICKY-TRAPS IN MISSISSIPPI

J. D. SOLOMON[1], R. E. DOOLITTLE[2], AND T. J. SPILMAN[3]

ABSTRACT

The 591 specimens captured represented 24 genera and 31 species. Some had never been previously collected in the study area.

The family Cerambycidae contains many species important to the forest industry either as economic pests of living trees and forest products or as beneficial decomposers of logging slash and other forest debris. Knowledge concerning the distribution of these insects is essential in developing and implementing control procedures against those which are pests. This note reports the capture of 591 cerambycid beetle specimens in west-central Mississippi near Stoneville.

The insects were taken during tests to study the sex pheromone of the carpenterworm, *Prionoxystus robiniae* (Peck), a lepidopterous pest in hardwood stands. Approximately 50 cylinder-platform sticky-traps[4] were operated in 1973, and about 100 were operated during 1974 and 1975. The traps were coated with a commercial sticky compound, and most were baited with a synthetic sex attractant for the carpenterworm. All cerambycid beetles trapped during May, June, and July from 1973 through 1975 were collected for identification.

The 591 cerambycid specimens taken during the study represented 24 genera and 31 species (table 1), three of which were identified only to genus. *Elaphidion mucronatum* (Say) was by far the most prevalent cerambycid species collected, as 394 specimens were taken compared to only 26 of the next most prevalent species (*Saperda lateralis* Fabricius). Eleven species were represented by single specimens. Since the insects were taken in both baited and unbaited traps, they were probably captured at random during dispersal flight rather than lured by the synthetic attractant.

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[4] Solomon, J. D. and R. E. Doolittle. Carpenterworm sex pheromone trap evaluation. Environ. Ent. (in press).

Table 1. Cerambycid beetles captured at Stoneville, MS., in sticky-traps used for carpenterworm sex pheromone studies from 1973 through 1975.

Species	Number and date captured		
	May	June	July
Orthosoma brunneum (Forster)	0	0	1
Derancistrus taslei (Buquet)	0	0	1
Oeme rigida rigida (Say)	9	0	0
Eburia quadrigeminata (Say)	0	1	1
Elaphidion mucronatum (Say)	157	140	97
Anelaphus pumilus (Newman)	6	0	0
Micranoplium unicolor (Haldeman)	2	1	0
Obrium maculatum (Olivier)	0	1	0
Dryobius sexnotatus Linsley	6	8	0
Physocnemum brevilineum (Say)	0	1	0
Xylotrechus colonus (Fabricus)	9	12	3
Neoclytus acuminatus acuminatus (Fabricus)	7	7	2
Neoclytus mucronatus mucronatus (Fabricus)	2	14	5
Neoclytus scutellaris (Olivier)	0	15	6
Neoclytus sp.	1	0	0
Typocerus velutinus (Olivier)	1	0	0
Goes debilis LeConte	0	1	0
Dorcaschema alternatum alternatum (Say)	2	2	0
Dorcaschema wildii Uhler	0	0	1
Hetoemis cinerea bimaculata Dillon & Dillon	2	0	0
Psapharochrus quadrigibbus (Say)	4	1	0
Leptostylus transversus (Gyllenhal)	0	2	1
Leptostylus sp.	1	0	0
Astyleiopus variegatus (Haldeman)	0	2	0
Lepturges confluens (Haldeman)	1	2	0
Eupogonius vestitus (Say)	0	6	0
Oncideres sp.	2	5	2
Saperda discoidea Fabricus	0	1	0
Saperda lateralis Fabricus	14	5	7
Saperda tridentata Olivier	4	4	2
Oberea tripunctata (Swederus)	1	0	0

A NOTE ON FOUR OLD SPECIES NAMES IN *COLASPIS* (COLEOPTERA: CHRYSOMELIDAE)

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In the Junk-Schenkling Catalogue of Chrysomelidae, section on Eumolpinae, there is under *Colaspis occidentalis* (Linnaeus) a number of names in synonymy; 2 of these represent valid species, and it is of these that I write. One of the 2 is *C. occidentalis,* described by Linnaeus in 1758 as *Chrysomela occidentalis;* I borrowed a specimen of this from the Lefèvre collection, Muséum National d'Histoire Naturelle, Paris. The other was described by Fabricius in 1787 as *Chrysomela flavicornis;* I borrowed the type of this from the University Museum, Copenhagen, Denmark.

Colaspis occidentalis (Linnaeus)

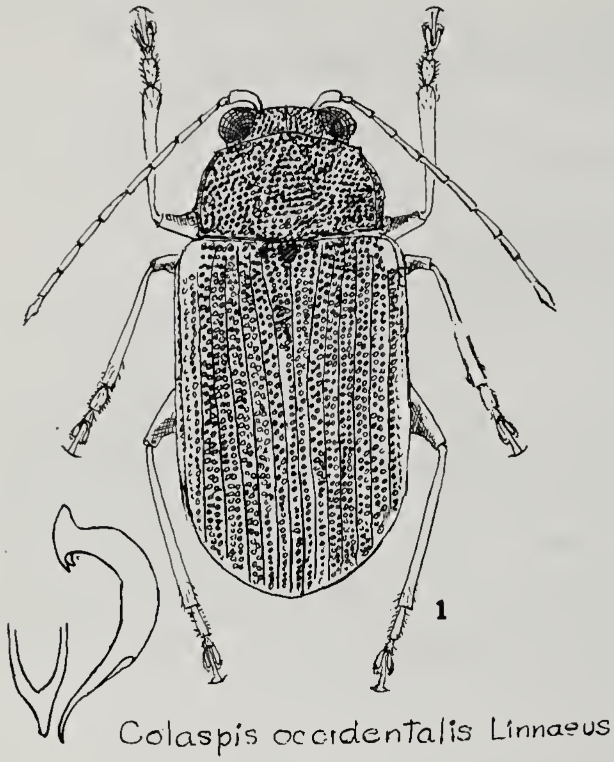
I give first a brief description of *C. occidentalis* (Fig. 1). It is a small beetle, about 5.8 mm long and 2.6 mm wide. Upper surface including scutellum entirely shining green; venter blue green; legs yellow brown; antennae entirely pale yellow. Head with interocular space not quite half width of head. Prothorax not twice as wide as long, sides toothed below middle, disc densely punctate. Elytra not 3 times as long as prothorax and slightly wider; punctures in single lines near suture and apex, elsewhere in alternate or double rows, with elevated dark green costae between rows. Type-locality, French Guiana. This species is smaller than most others of the group.

I also illustrate *C. flavipes* (Fabricius), originally described in *Erotylus* (Fig. 2); the type-locality of this also is French Guiana. The U. S. National Museum has 5 specimens from Cayenne, French Guiana, that strongly resemble the one in the Lefèvre collection called *C. occidentalis*—so much so that I am certain that *C. flavipes* is a synonym of *C. occidentalis.* My illustration is from 1 of these specimens; it shows not only that the beetle itself is like *C. occidentalis* but that the aedeagus is the same.

Colaspis flavicornis (Fabricius)

C. flavicornis (Fig. 3) is a larger beetle, the type-specimen about 6.5 mm long and 4.0 mm wide. Coloration similar to that of *C. occidentalis* except tip of last antennal article dark, and scutellum dark rather than shining green. Head with interocular space half width of head and densely punctate. Prothorax not twice as wide as long, sides toothed below middle, disc densely punctate. Elytra more than 3 times as long as prothorax and wider; dense punctures in double rows except near suture and apex, with well marked costae between rows. There is no indication on the type-specimen as to where it was collected.

This beetle is so like *C. prasina* Lefèvre (Fig. 4) that I believe these 2 names are synonymous. I have seen the type of *C. prasina,* collected at Fugasugo, Colombia; my illustration is of this specimen, the inset showing the form of the aedeagus. **New synonymy.**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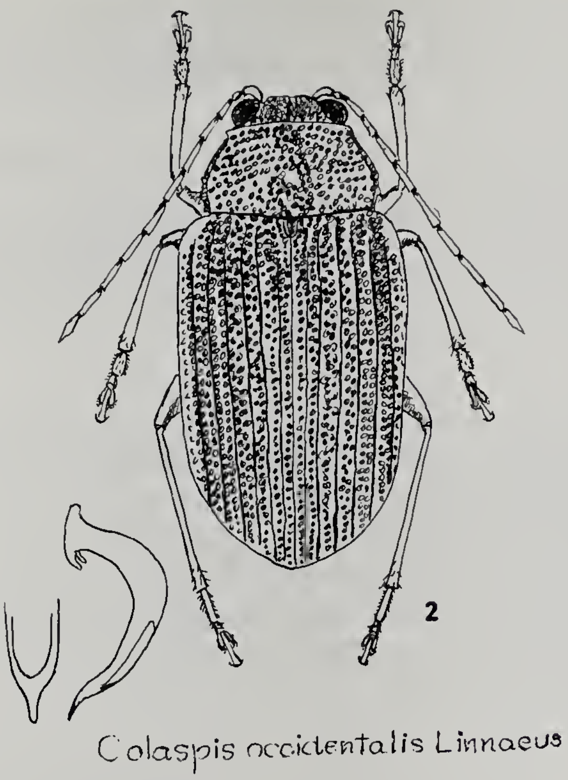
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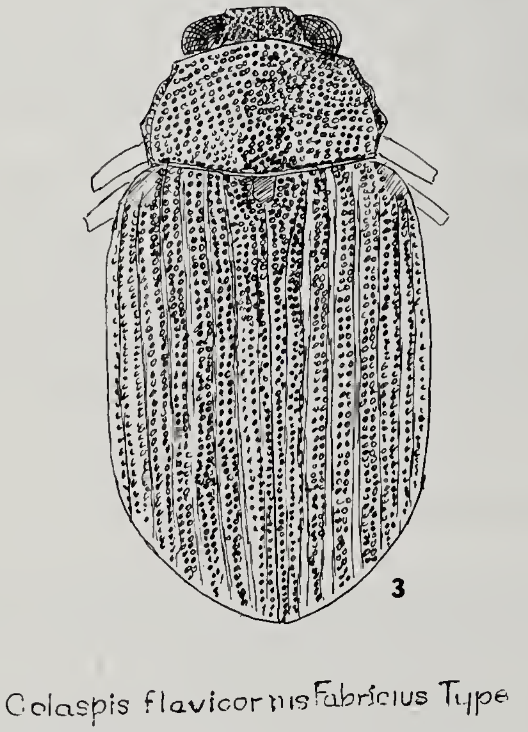
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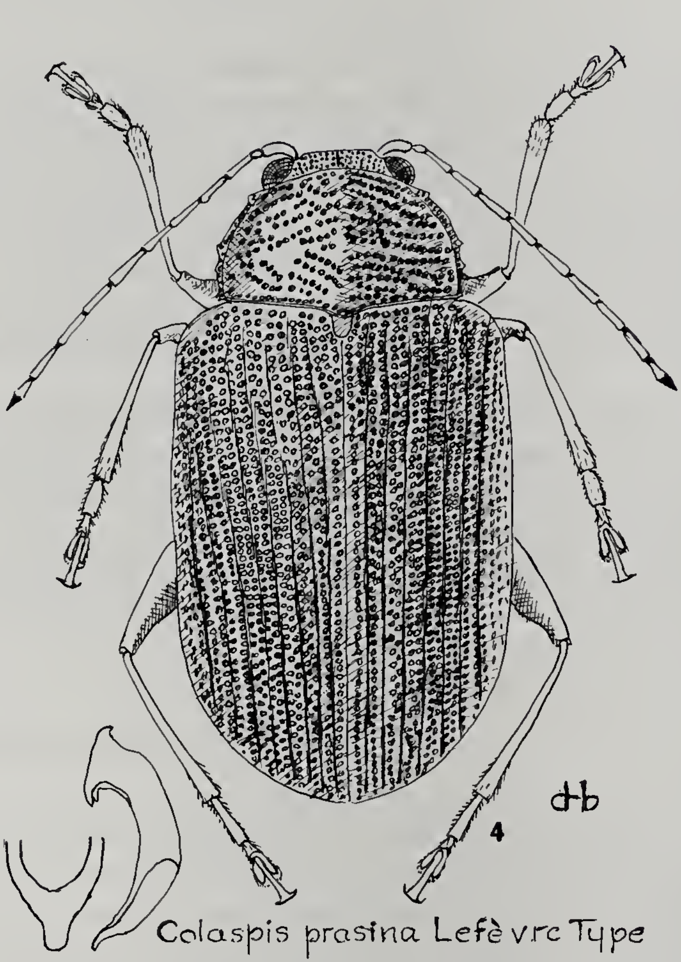
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Fig. 1-2, *Colaspis occidentalis* (Linnaeus): 1) type-specimen, French Guiana; 2) specimen of form called *C. flavipes* (Fabricius), showing similarity in habitus and male genitalia, from Cayenne, French Guiana. These 2 names are synonyms.

Fig. 3-4, *Colaspis flavicornis* (Fabricius): 3) type-specimen, locality not known; 4) type-specimen of form called *C. prasina* Lefèvre, Fugasugo, Colombia. These 2 names are synonyms.

CALOSOMA (CARABOMIMUS) CICATRICOSUM BALLI, NEW SUBSPECIES (COLEOPTERA: CARABIDAE)

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ABSTRACT

A new subspecies of *Calosoma cicatricosum*, *C. c. balli*, is described from MEXICO, State of Mexico; the nominotypical form is known only from Mexico, D. F. and immediate vicinity.

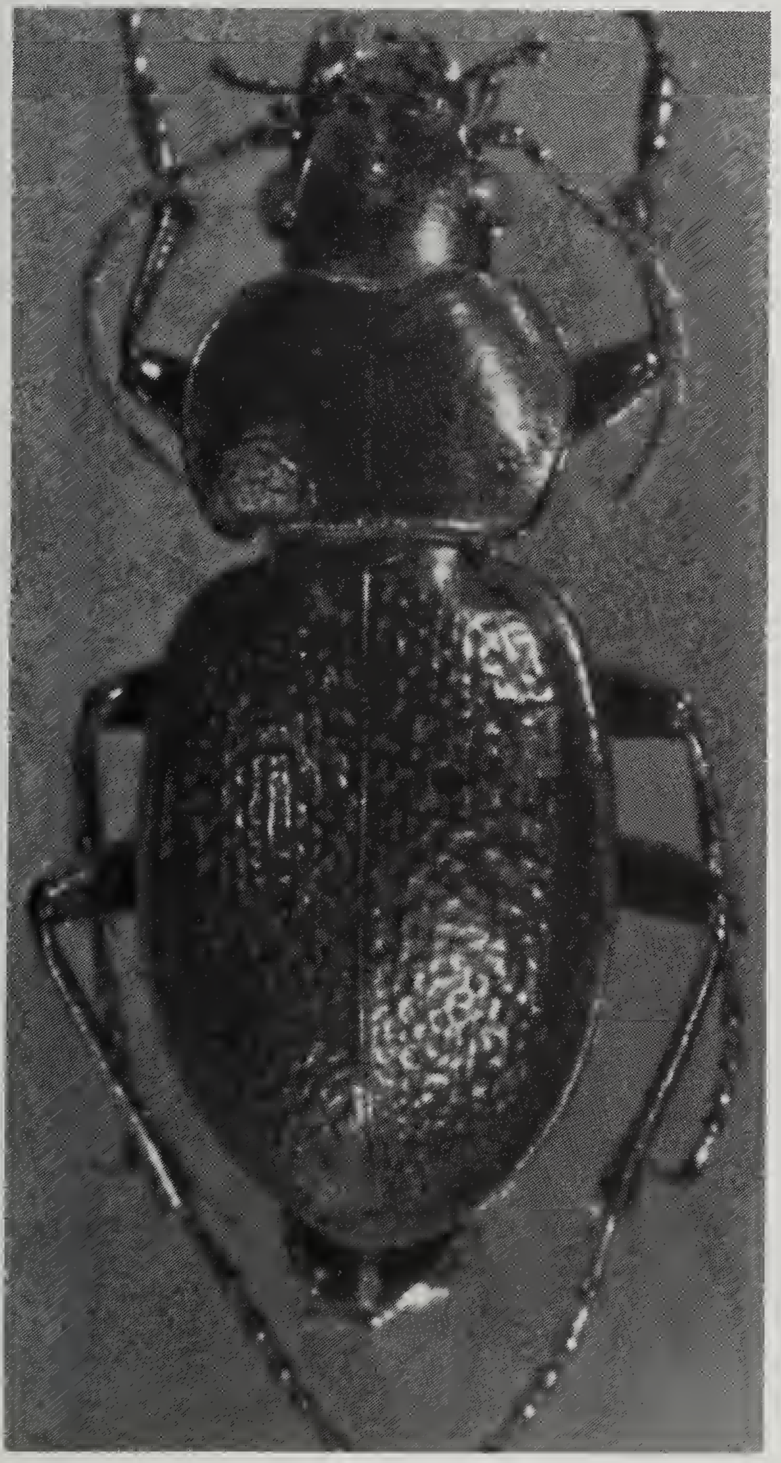

Fig. 1, *Calosoma cicatricosum balli*, male.

Calosoma Cicatricosum Bali Rotger, **new subspecies**

Comparisons. Members of this subspecies are generally similar to those of nominotypical *C. cicatricosum* Chaudoir but differ in the following characters. *Antennae*: each article about 1/4 shorter than in *C. c. cicatricosum. Pronotum*: lateral margins more rounded, shorter; hind angles less rounded than in *C. c. cicatricosum. Elytra*: outline round-oval rather than oblong-oval.

Measurements of 1 male of *C. c. cicatricosum*: pronotum 3.0 mm long, 4.25 mm wide; elytra 10.0 mm long, 5.5 mm wide. Figures given by T. Gidaspow correspond with these measurements.

Measurements of 10 males of *C. c. balli*: pronotum 2.5-3.0 mm long (mean 2.75 mm), 4.75-5.0 mm wide (mean 4.77 mm); elytra 7.0-8.5 mm long (mean 8.37 mm), 5.5-6.0 mm wide (mean 5.7 mm).

Measurements of 10 females of *C. c. balli*: pronotum 2.5-2.75 mm long (mean 2.67 mm), 4.25-5.25 mm wide (mean 4.77 mm); elytra 8.0-9.0 mm long (mean 8.37 mm), 6.0-6.5 mm wide (mean 6.07 mm).

Description. Body form and dorsal surface as in fig. 1. Total length 13.5-17.5 mm (mean 14.65 mm), for both males and females. *Microsculpture.* Generally isodiametric, meshes slightly transverse on ventral surface. *Macrosculpture.* Head with numerous fine punctures on frons and vertex, surface with fine vermiculose lines anastomosed in form of irregular cells. Pronotum with punctures in lateral grooves, not on disc; surface with fine, vermiculose lines, as on head. Elytra vermiculate-punctate, striae evident on disc but interrupted; strial pattern not evident on apical declivity. Abdominal sterna punctate laterally, median areas vermiculate-strigose, anal sternum more deeply so. *Setae.* Lateral setae of pronotum at basal 1/4. Hind coxa bisetose. *Pronotum.* Lateral margins rounded, more strongly incurved posteriorly than anteriorly; dorsal surface with disc flattened, moderately declivous laterally, more strongly so anteriorly than posteriorly; hind angles rounded, distinctly but slightly extended posteriorly beyond median portion of posterior margin. *Elytra.* Outline round-oval. *Male genitalia* Median lobe with apex about as in *C. c. cicatricosum* (see Gidaspow 1959, fig. 152); ligula of similar proportions to that illustrated for *C. c. cicatricosum*, but flanges more angulate posteriorly.

Type-material. Holotype male and allotype female in my collection, and 56 paratopotypes, all collected by me in MEXICO, State of Mexico, on 2-VI-65 and 23-IX-65, about 1 mile from Santa Marta, Distrito de Ocuilan, on a meadow under stones. These paratypes distributed as follows: 4 to G. E. Ball, Edmonton, Alberta, Canada; 2 each to Jacques Negre and Joaquin Mateu, Paris, France; 2 to Candido Bolivar, Mexico City, Mexico; 2 to Carlos de Wendler-Funaro, Green Valley, Arizona; 2 to Francisco Español, Barcelona, Spain; and 2 to U. S. National Museum. Additional paratypes as follows: 30 paratopotypes taken by J. Mateu on 12-IX-73; 6 paratypes collected by J. Mateu at La Huerta, State of Mexico; and 6 paratypes collected by Gonzalo Halffter at La Marquesa, State of Mexico.

ACKNOWLEDGMENTS

Mr. Joaquin Mateu of Laboratoire d'Evolution, Paris, told me that the above form represented an undescribed subspecies, and Dr. George E. Ball made useful suggestions and provided the photo used herein.

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JEANNEL, R. 1940. Les Calosomes. Paris. Mem. du Mus. Nat. d'Histoire Naturelle 13:1-240, pl. 1-8.

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A NEW SPECIES OF *ODONTODERES* FROM BRAZIL (COLEOPTERA, CURCULIONIDAE, CHOLINAE)

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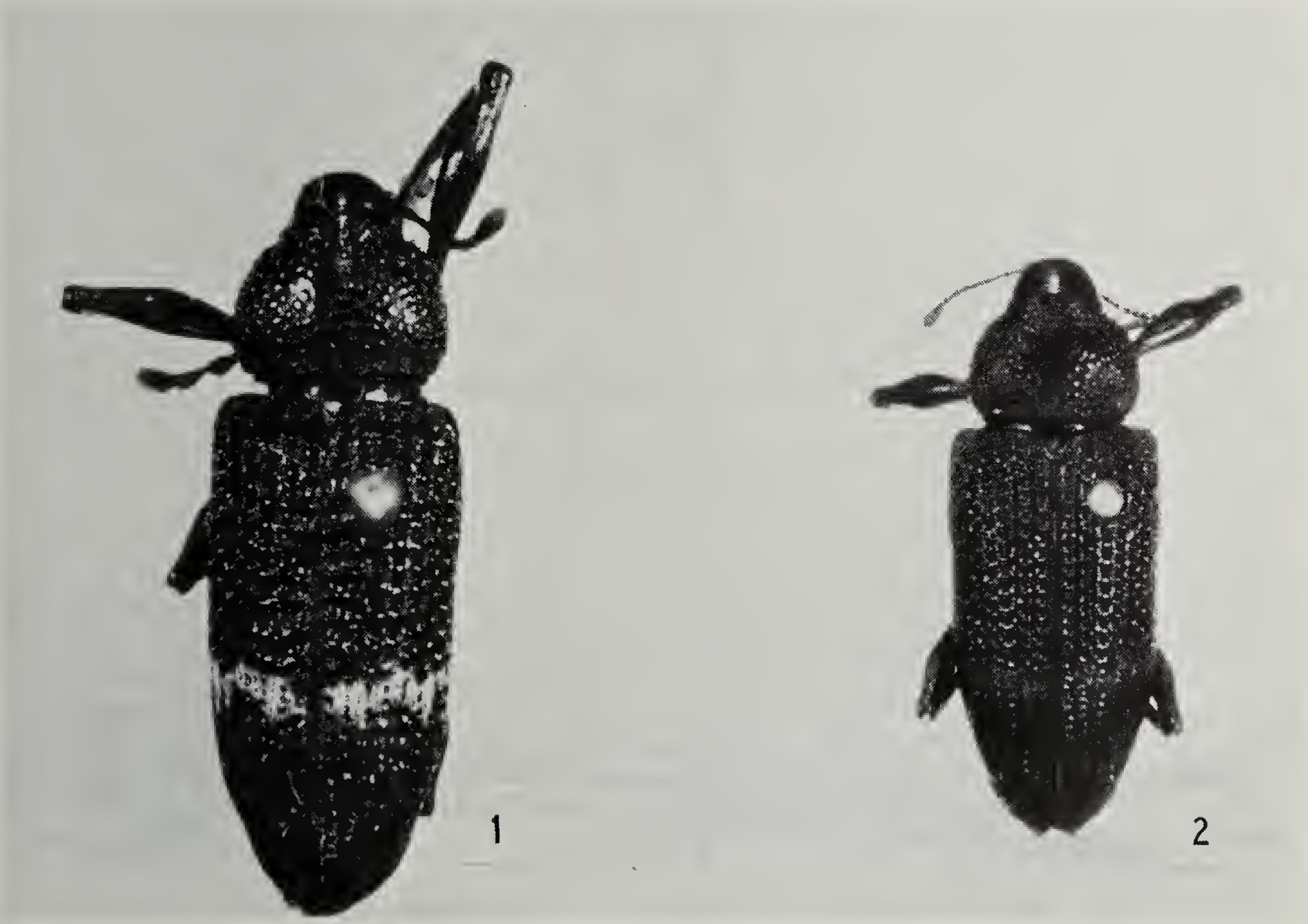
After publication of my revision of *Odontoderes* (1974), I received from Dr. Hans Reichardt, Museu de Zoologia, São Paulo, 3 specimens of this genus, of which the female agreed with 2 females I had examined previously but did not describe because 1 of them was in rather bad condition and because I had no male. These specimens represent a new species which I call:

Odontoderes elongatus Vaurie, **new species**

Holotype male, Cachimbo, Para, Brazil, October, 1955, Padre Pereira, collector, and 1 female paratype, same data, in Museu de Zoologia, São Paulo; 1 male paratype, same locality, but November, 1955, J. A. Araujo, collector, in American Museum of Natural History; 1 female paratype, Rio de Janeiro, in Kuschel collection, DSIR, Auckland; 1 female paratype, Corumba, Mato Grosso, Brazil, in Muséum National d'Histoire Naturelle, Paris.

Diagnosis. O. elongatus differs from other species by being mostly black and shining rather than mottled with brown and white scales, by lacking white scales on pronotum, and by having only 1 postmedial transverse white scaly band on elytra or no band at all. Beak and elytra very long.

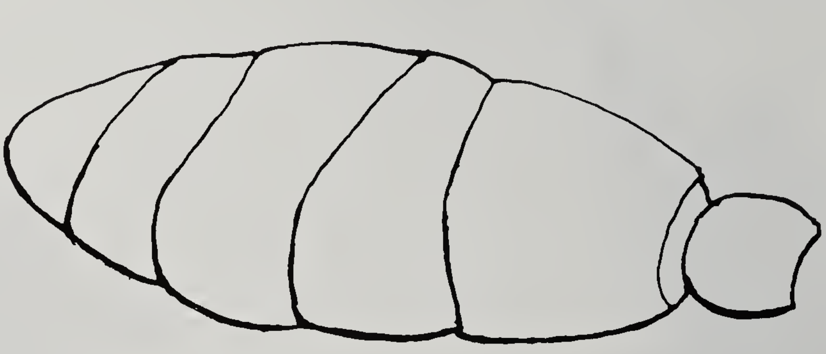


Figs. 1, 2. *Odontoderes elongatus*. 1. Type, male (15 mm.). 2. Paratype, female (20 mm.). Not to same scale.

Description of type. Male; 15 mm, shining black with white scales on scutellum and in transverse, slightly irregular band behind middle of elytra. Beak 1 1/2 times length of pronotum, apically feebly deflexed, dorsally multicarinate to near apex, ventrally punctate. Labium flat. Antennal funicle with segment 2 slightly longer than 1. Pronotum narrower than elytra; disc rather flat, medially impunctate; sides arcuate, front not spined but with 2 tubercles slightly more conspicuous than other tubercles. Scutellum subtriangular. Elytra almost 3 times length of pronotum; striae with deep foveae separated by transverse tubercles; intervals much narrower than striae and with sparse, wispy, semi-erect hairs about as long as scutellum; base straight; apexes angularly separate. Prosternum slightly concave; front coxae separated by width of funicular segment, mesially flattened; mesosternum tumid, hairy; coxae, metasternum, and concave abdominal segments 1 and 2 with long, wispy hairs. Front tibia with inner margin feebly sinuate; front tarsus longer and wider than other tarsi; tibiae with elongate punctures; legs not tuberculate. Median lobe with apex triangular, slightly tipped upward; parameres and strut of tegmen very long; basal sclerite not found.

Variation from type. The male paratype is almost exactly like the type. The 3 females are larger (17 to 20 mm.); beak straighter, longer (almost twice length of pronotum), smooth, ecarinate; elytra 3 times length of pronotum; abdomen convex, not concave, under side not abundantly hairy; and front of pronotum with lateral tubercles not conspicuous. The female from Rio de Janeiro lacks the elytral white band, but has scattered white flecks and minute brownish scales throughout the elytra, producing a grayish appearance. Wispy hairs on the elytral intervals of both sexes can be discerned in a good light, but are apparently lacking in the female from Corumba.

Remarks. This species belongs near the *morbillosus-spinicollis* group of *Odontoderes*, but the male lacks the pronotal spines characteristic of the group. The aedeagus is similar to those of these 2 species, and also to that of *O. sexmaculatus* Olivier. The general body shape resembles that of *O. insculptus* Vaurie (1974, fig. 21),but the elytra appear even longer and the apexes are separated in 2 little angles, not conjointly rounded; the aedeagus is quite different.



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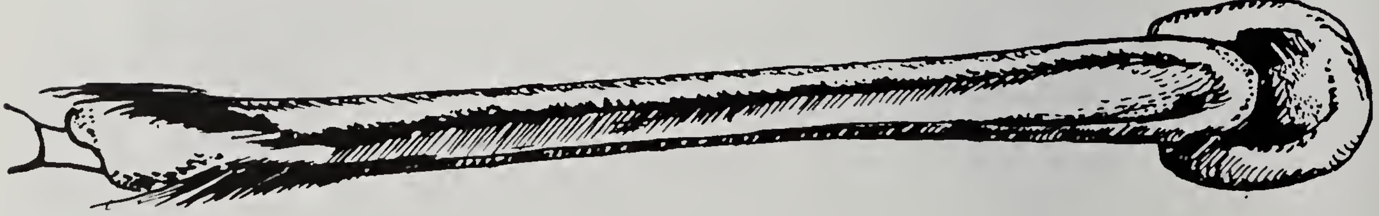

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Figs. 3, 4. Generic characters of *Odontoderes*. 3. Antennal club and 7th funicular segment. 4. Canaliculate tibia.

A dissected female from Guaruja (?), São Paulo, may be this species, but the beak is shorter, less straight, and is only 1 1/2 times the length of the pronotum (as in the male of *elongatus*); there are no visible scales and the pronotum is tuberculate medially and laterally, but impunctate each side of the center.

In my key (1974: 12), *O. elongatus* would go to couplet 21 where it does not agree with either part. Therefore there should be substituted at 21 the following:

21(20). Small (10 to 13 mm.); elytra not more than twice length of pronotum; postmedial white scaly band oblique .... *brevis* Vaurie
21′. Larger (15 to 26 mm.); elytra 2 ½ to 3 times length of pronotum; postmedial white band oblique or transverse, or elytra white-spotted, or indistinctly mottled, or immaculate 21a

21a(21′). Elytra 3 times length of pronotum, either without white marks or with postmedial white band transverse; pronotum immaculate .... *elongatus*
21a′. Elytra 2 ½ times length of pronotum, mottled with indistinct whitish bands or stripes, or with large yellowish spots; pronotum generally with white lateral stripes 22

The genus *Odontoderes* is distinguished from other genera of *Cholinae* in having the outer edge of the tibiae bicarinate or canaliculate (fig. 4) and the sinuate basal segments of the antennal club clasped by the straight 7th funicular segment (fig. 3).

LITERATURE CITED

VAURIE, P. 1974. Revision of the South American genus *Odontoderes* (Coleoptera, Curculionidae, Cholinae). Amer. Mus. Novit., no. 2542: 1-35, figs. 1-85.

* * *

CORRECTION

I recently noticed that in my paper on the New World Gymnetini (Coleopt. Bull. 29(3):205-208) I made an unfortunate spelling error. The generic name *Cotinis* appears throughout the paper as "*Cotinus*", and *Heterocotinis* is spelled "*Heterocotinus*".

I also neglected to list *Aemilius* LeMoult and *Aemilius wagneri* LeMoult (1939; Novitates Entomologicae 10:79-80) from Argentina, these should probably be placed between *Gymnetis* and *Gymnetosoma*.

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BOOK REVIEW

Phenology and seasonality modeling, edited by Helmut Lieth. 1974. Springer-Verlag New York, Inc., 175 Fifth Avenue, New York, NY 10010. Hardbound, 444p., $47.80.

Most of the papers in this very informative volume were originally presented at a symposium conducted at the 25th Annual AIBS Meeting in Minneapolis in 1972. The 38 contributions are nicely arranged into 6 Parts: (1) Introduction to phenology and the modeling of seasonality; (2) Methods for phenological studies; (3) Seasonality in trophic levels; (4) Representative biome studies; (5) Modeling phenology and seasonality; (6) Applications of phenology. Insect ecologists will probably find that at least half of the chapters provide some meaningful information for them. One paper specifically deals with phenology and seasonal modeling in insects and it is presented simply and clearly. It contains definitions of insect phenophases and it presents short discussions on seasonal arrival and departure of insects and on modeling seasonality in insects. Entomologists interested in obtaining a basic introduction to insect phenology would do well to read this paper along with a recent paper by Tauber and Tauber (1973—see literature notice below) which contains an extensive list of references.

LITERATURE NOTICE

Insect phenology: Criteria for analyzing dormancy and for forecasting postdiapause development and reproduction in the field, by Maurice J. Tauber and Catherine A. Tauber. Search (Agriculture), Cornell Univ. Agr. Exp. Sta., Ithaca, N.Y. Vol. 3, No. 12, pp 1 to 16. Nov., 1973.

—Paul P. Shubeck

BOOK NOTICES

Pollution ecology of fresh water invertebrates, edited by C. W. Hart, Jr. and S. L. H. Fuller. 1974. Academic Press, Inc., 111 Fifth Avenue, N. Y., N. Y. 10003. Hardbound, 389p., $24.50.

Insect flight, edited by R. C. Rainey. 1976. Halsted Press, Div. of John Wiley & Sons, Inc., 605 Third Ave., N. Y., N. Y. 10016. Hardbound, 288p., $47.50.

Biogeography: an ecological and evolutionary approach, 2nd Edition, by C. Barry Cox, Ian N. Healey, and Peter D. Moore. 1976. Halsted Press, Div. of John Wiley & Sons, Inc., 605 Third Ave., N. Y., N. Y. 10016. Paper, 194p., $9.95.

An introduction to biological rhythms, by John D. Palmer. 1976. Academic Press, Inc., 111 Fifth Avenue, N. Y., N. Y. 10003. Hardbound, 392p., $19.50.

—Paul P. Shubeck

NOTES ON THE LIFE HISTORY AND ECOLOGY OF *CALLIGRAPHA SPIRAEAE* (SAY) (COLEOPTERA: CHRYSOMELIDAE)

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Abstract

The life history and ecology of *Calligrapha spiraeae* (Say) on *Physocarpus opulifolius* in Virginia are discussed. Eggs are laid on the underside of the food plant leaves, on which the first 3 larval instars feed. Third instar larvae enter soil where a fourth larval molt occurs, preceeding pupation. Adults emerge in early August, over-winter, and mate in the spring. One egg parasite was observed, and mention is also made of possible larval and adult parasites.

Life history studies that have been done on the chrysomelid genus *Calligrapha* have been largely on the few species that feed on economically important plants and which under certain conditions can become serious defoliators. Earlier works on these beetles include: Hegner (1908, 1910), observations on the life histories of *C. multipunctata* (Say), *C. bigsbyana* (Kirby), and *C. lunata* (Fabricius); Whitehead (1919, 1920) additional data on *C. bigsbyana*, based on rearing 2 egg clusters; Ainslie (1925), on *C. pnirsa* Stal; Daviault (1941), an excellent study on *C. multipunctata* var. *bigsbyana*; and Dean (1946), on *C. scalaris* LeConte.

Calligrapha spiraeae (Say) feeds on *Physocarpus opulifolius* (L.) (Rosaceae; common name, ninebark) and can be readily reared on leaves of this plant. This plant flourishes along banks of water courses and especially on rocky talus slopes. The distribution of this plant includes the upland regions of eastern United States (Fig. 1). The distribution of the beetle is not well known. I have learned through personal communications with Robert H. Perry and E. C. Becker that the collections of the USA and Canada have specimens of this beetle from Quebec and 7 eastern states and I have collected specimens in Virginia and North Carolina (Fig. 1).

Laboratory rearing methods were similar to those used by Hegner (1908). Adults emerge during April and, after a short feeding period, begin mating. The male may remain mounted on the female for as long a 6 hours. Females lay a double row of eggs on the underside of the leaves of the food plant. About 1 minute is required to lay each egg. Egg laying by each female lasts an average of 10 days, about 60 eggs the average number laid. Incubation time for the eggs is 7 days. The first 3 larval instars last 7 days apiece, on leaves of the food plant. The fourth larval instar lasts 10 days, does not feed, occurs in the soil, and leads to the pupa which also has a duration of 10 days. The new adults emerge from the soil in late August, feed for 2 weeks, re-enter the soil to overwinter, and mate during the following spring. The adults and newly hatched larvae do not hesitate to devour the eggs of their own species.

The small pteromalid egg parasite, *Erixestus winnemana* Crawford, is known to parasitize other *Calligrapha* (Daviault, 1941) and was first described from specimens obtained from the eggs of *C. bigsbyana* and *C. scalaris* (Crawford, 1910). Parasitized eggs of *C. spiraeae* can be readily recognized since outlines of the developing wasp can be seen in such eggs. The life cycle of this wasp is 7 days, allowing several generations to be produced in each summer.

Daviault (1941) reported a braconid wasp as a parasitoid of larvae and the tachinid fly, *Doryphorophaga dorsalis,* as a parasite of the adult of *C. multipunctatus* I found neither of these associated with *C. spiraeae,* but it seems reasonable to assume that these parasites do attack this beetle also.

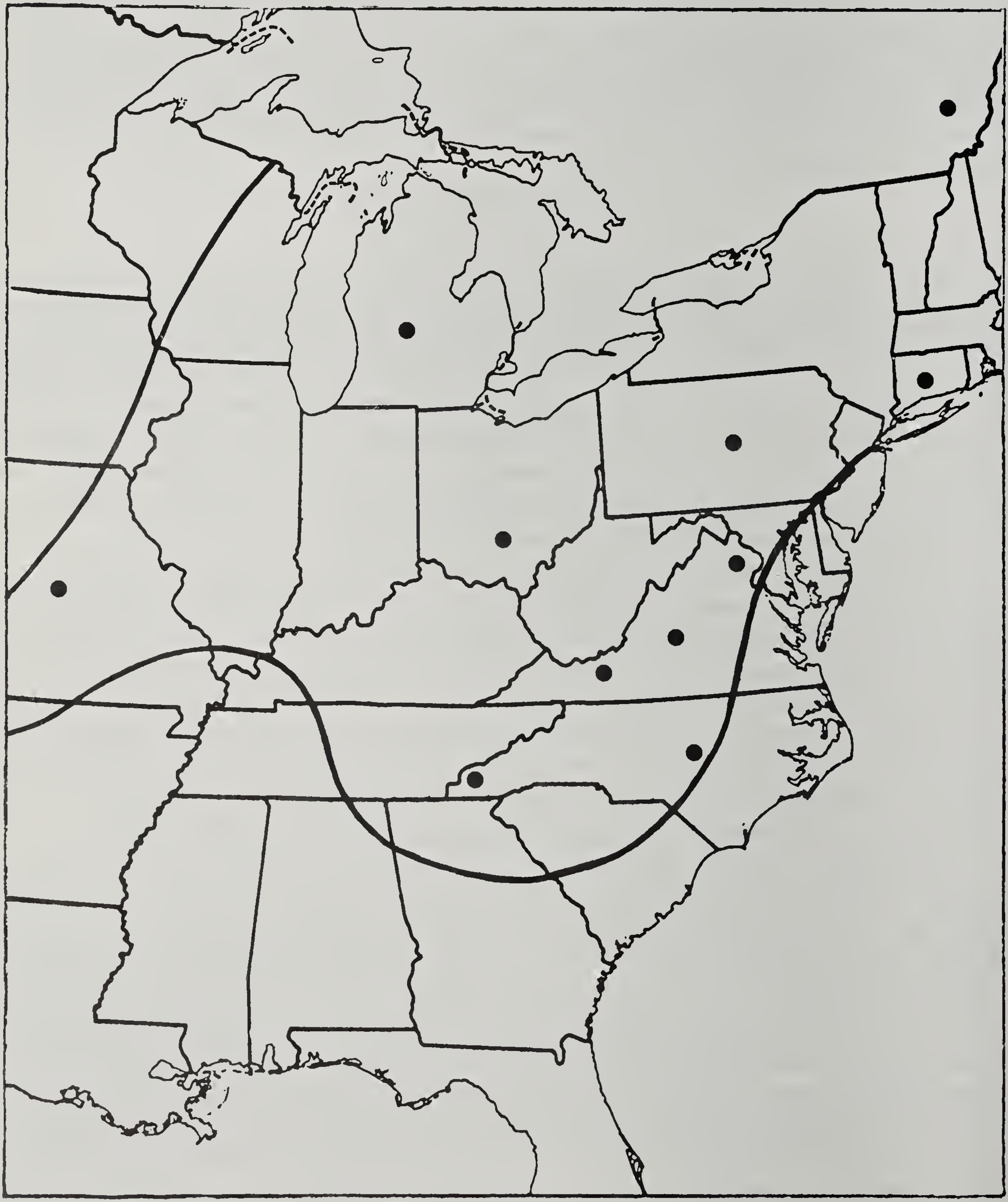

Fig. 1. Distribution of *Physocarpus opulifolius* in the United States (heavy line) and known localities for *Calligrapha spiraeae* (dots).

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OBSERVATIONS ON THE MATING BEHAVIOR OF *PSEUDOCOTALPA GIULIANII* HARDY

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On April 29, 1974, in company with T. D. Eichlin, I had the opportunity to observe an evening's activity of *Pseudocotalpa giulianii* Hardy at Big Dune, Nye County, Nevada.

Throughout the afternoon, scattered individual adults were uncovered at depths of 4 to 6 inches as we sifted the sand beneath Creosote bushes (*Larrea divaricata* Cav.). No adults were active until late afternoon, about 1 hour before dark. Our first indication of activity was the slow flight of solitary individuals hovering near the tips of Creosote plants. First activity was at least 1/2 hour earlier than I have observed for *Pseudocotalpa andrewsi* Hardy and *P. sonorica* Hardy. The number of individuals rapidly increased until they could be seen in every direction at the tops of the Creosote bushes.

Females were on the creosote branch tips, where they were evidently emitting a pheromone. The males hovered downwind from the tips of the branches, attempting to locate the female.

Large numbers of males were hovering downwind from branches where no female was present. Evidently there was pheromone on the branches, probably from the previous night (because our observations were made during the earliest minutes of the emergence, when there had probably not been sufficient time for a female to have moved to the plant, mated, and
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departed). One such swarm of males was found to contain at least 9 individuals, but most swarms were smaller, usually with 3 to 6 males.

Final location of a female is evidently visual, as no attempt to land on the branches was made by a male unless a female was present. Males investigating branches on which no female was present continued to hover and move gradually back and forth for prolonged periods of time.

The observers could approach from downwind easily to within 2 or 3 feet of the flying males without any change in behavior pattern, whereas approach from upwind resulted in the breakup and dispersal of the swarm while the observers were still 15-20 feet away.

Two matings were observed. The first was at the tip of a creosote branch and lasted for approximately 2 minutes. The male was observed to land on the branch and crawl to the female, mounting her from behind. Upon mounting, the male immediately commenced stroking the prothorax and head of the female with the antennae, simultaneously rubbing the apex of the female's elytra with his hind legs. This lasted for less than a minute, and was immediately followed by a successful attempt at genital insertion. At this point activity ceased, except for a rhythmic pumping of the male's abdomen until withdrawal less than a minute from the time of insertion. The adults then disengaged, and the male began to take wing, at which point the pair was collected.

The second observed mating is perhaps less typical. Several beetles were observed to be rolling in the sand in a ball, after most activity by other adults had ceased. Upon closer examination this ball was found to comprise a male laying on his back on the sand, grasping a female in a mounting position, both insects inverted, the female waving her legs in the air and attempting to right herself. An additional male was crawling over the pair, evidently attempting to find a mating position. This chaotic activity lasted for at least 5 minutes, at which point the extra male wandered off into the approaching darkness and burrowed into the sand. Shortly thereafter, the remaining male successfully attempted genital insertion and copulation occurred in the inverted position. Activity then ceased until withdrawal about a minute later, when the female regained her feet and wandered a few inches and began to burrow into the sand. The male attempted for several more minutes unsuccessfully to regain his feet and was collected.

Intense activity seemed to last for approximately 1/2 hour. As darkness began to fall, the beetles could be found on the surface of the sand, or digging into the sand. Tracks on the surface were easily utilized to find the buried beetle, about 4" deep in the sand. Most of the insects burrowed in the surface of the open dune, away from any vegetation. Until we retired at 11:00 p.m., we could still encounter an occasional beetle on the surface of the sand, usually on its back. However, most beetles had burrowed into the sand by nightfall.

Other observers report (*in litt.*) that in areas lacking creosote bushes on the sand, copulation takes place on the surface.

Random collecting resulted in the capture of 109 males and 14 females, probably a fair estimate of the sex ratio. After collection, 5 females were preserved and sent to P. Ritcher who reports all were gravid.

Indications are that this species is rarely attracted to a fluorescent blacklight.

* * *

ERIOCEREOPHAGA HUMERIDENS, A NEW GENUS AND SPECIES AND POTENTIAL BIOLOGICAL CONTROL AGENT FROM BRAZIL (CRYPTORHYNCHINAE, CURCULIONIDAE, COLEOPTERA)[1]

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ABSTRACT

This new monotypic genus (and new species) of Brazilian cactus feeding weevil, being considered as a biological control agent for *Eriocereus* cactus in Australia, is described. Outline illustrations of its habitus and of the male and female genitalia are included, as are diagnoses of related or similar neotropical genera.

Recently I was asked to identify an unusual Brazilian weevil being considered as a potential biological control agent for *Eriocereus* cactus in Australia. After a careful check of the literature and a study of the types of many related genera and species in European museums, I determined that it represents an undescribed genus and species in the subfamily Cryptorhynchinae, tribe Cryptorhynchini, subtribe Tylodina.

All of the specimens used in this study were laboratory reared from parent stock collected as larvae and pupae in the cactus *Eriocereus adscendens* (Gurke) from near Arcoverde, Pernambuco, Brazil and from various localities in the states of Bahia and Pernambuco. Additional hosts known are seedling cacti of 2 other genera, *Cereus jamacaru* DeC. and *Cephalocereus gounellei* Weber (R. E. McFadyen, Pers. Comm.). Dr. McFadyen will publish on the biology of the weevil and I shall publish a separate paper on the morphology of the immature stages.

Eriocereophaga O'Brien, **new genus.**

Large, body robust, in large part clothed with scales. Rostrum shorter than prothorax, received in deep sternal groove in prosternum and mesosternum. Eye (if rostrum at rest in sternal groove) ca. 1/2 covered by rather weakly developed ocular lobe. Antennae with 7 funicular segments, these with moderately coarse bristles, only segments 1 and 2 slightly elongate; club annulate, densely finely pubescent; scrobe deep, dorsal margin directed towards basal 1/3 of eyes. Prothorax wider than long, rugosely unevenly punctate and/or tuberculate, fasciculate, strongly and deeply constricted near apex. Scutellum minute, scarcely or not visible. Elytron 10 striate, 10th stria ending opposite hind coxa, striae strongly punctate, each puncture with round or elongate scale; humeri lacking; suture fused; hind wings lacking. Metepisternum fully developed, clearly visible. Abdominal sternum 2 nearly as long as 3 and 4 together, subequal to 5; sutures deep, weakly curved to straight. Femora elongate, slender, unarmed. Tibiae uncinate and with minute scarcely visible praemucro. Tarsal claws small, fine, and simple.

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[1] This study was supported in part by grants from the Cooperative State Research Service, United States Department of Agriculture, Grant Numbers 716-15-22 and 416-15-16 to Florida A and M University.

Etymological note. This feminine generic name is the result of combining 2 words, the Greek-Latin hybrid, *Echinocereus*, the genus of host cactus of the type series, and the Greek *phagein* = to eat.

Taxonomic notes. This monotypic genus keys to couplet 11 in Fiedler's (1940) key to the American genera of Tylodina, with *Pseudoacalles* and *Tylodinus*. Species of *Pseudoacalles* are presently known only from the southern United States and the West Indies and have a long slender rostrum and distinctly toothed (armed) femora. Species of *Tylodinus* are from Mexico and Central America and have a basally strongly widened rostrum, several well-developed basal dorsal elytral tubercles, and the first 2 funicular segments greatly elongated.

Eriocereophaga closely resembles species of the tropical New World genus *Tylodes,* but the latter have the metepisternum not visible and the basal 3 or 4 funicular segments elongate. Species of *Gerstaeckeria,* cryptorhynchine cactus weevils from Peru, Ecuador, Mexico, the United States, and Canada, are also similar to *Eriocereophaga,* but can be readily separated by their lack of visible metepisterna and the strong expansion of the basal portion of the rostrum from the antennal insertion. These genera also lack the strong circumocular and transverse frontal groove.

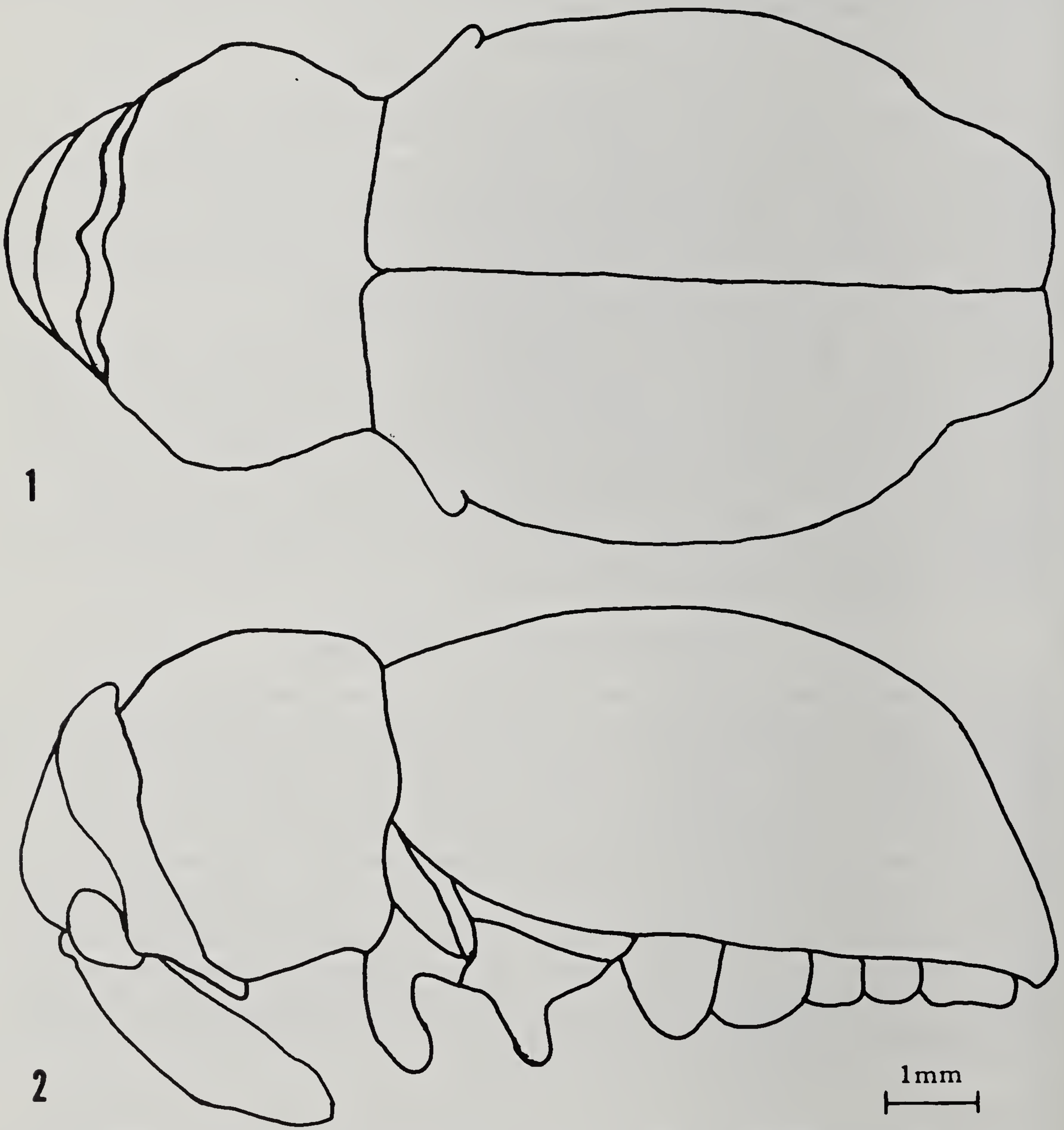

Fig. 1-2 *Eriocereophaga humeridens* holotype male: 1) dorsal view; 2) lateral view.

Eriocereophaga humeridens O'Brien, **new species.**

Black to piceus, clothed with brown, white and black scales.

Holotype: Male. Length, pronotum and elytron, 11.1 mm. Rostrum very stout, weakly curved; with distinct median carina on basal 2/3; lateral margins straight in basal 1/2, curved and expanded above antennal insertion, apex strongly expanded, basal 1/2 with deep longitudinal lateral groove clothed with dense erect white and tan scales (groove dorsally continuous around eyes to posterior margin and across frons between eyes), cuticle reticulate between groove and glabrous shining carina, basal 1/6 of carina broad and irregular, broadest at base and completely reticulate; basal of 2/3 of rostrum coarsely unevenly punctate; apical 1/3 finely, more evenly punctate, shining, not reticulate. Antenna inserted at apical 1/3, red brown to black; funicular segments 1 and 2 elongate, subequal; 3, 4 and 5 shorter than 1, subequal; 6 and 7 short, broadly transverse; all segments with long moderately sparse setae, 7 also with moderately dense recumbent pubescence; club short, subacuminate. Head strongly convex, reticulate, with large deep unevenly spaced punctures, many confluent, with fine to coarse setae and/or scales in punctures, some confluent punctures forming median longitudinal groove near apex to middle of vertex, groove with coarse erect scales; with fine, shining, glabrous, contiguous, dense, transverse striate grooves near base (hidden by prothorax if rostrum is not at rest in sternal groove); eye subreniform, weakly convex.

Prothorax transverse, ca. 1/7 to 1/8 broader than long, apex narrower than base, strongly angled behind middle, strongly, deeply constricted behind apex dorsally and laterally to margin of prosternal sulcus; dorsally area anterior to groove steeply slanting, posterior margin of area somewhat carinate, with distinct median emargination, with (narrow glabrous finely sparsely punctate) transverse anterior margin, remainder densely clothed with recumbent black scales, with 5 transversely spaced white spots, median spot in and in front of emargination; disc convex behind transverse constriction, reticulate anterior median half with broad carina, anterior 1/4 with lateral impunctate areas, behind with lateral submedian tubercles, tubercles fasciculate with dense black scales, opposite these lateral margins with fasciculate tubercles at widest point of prothorax, tubercles fasciculate with dense white and black scales; posterior 1/2 of disc rugosely punctate and/or tuberculate; main body of disc with sparse black, white, and/or brown scales.

Elytra strongly inflated, moderately constricted basally, with distinct lateral scale covered process behind constriction; disc mainly clothed with dense scales; base in front of constriction and flat sutural interval reticulate, with very sparse small scales; other intervals weakly convex, except interval 9 very strongly convex from declivity to apex; all densely clothed with broad, recumbent, imbricate white and brown scales and fascicles of suberect black scales, and with uneven rows of suberect, elongate brown and/or white scales; color pattern subfasciate, pale fasciae posthumeral, postdeclivital, and subapical; apex behind declivity suddenly narrowed, conjointly rounded; strial punctures distinct, largest on disc and 1st striae, gradually smaller laterally and posteriorly, striae between punctures strongly longitudinally convex, nearly scale-covered, usually poorly defined. Venter reticulate, unevenly punctate and unevenly scale covered. Fore and mid coxae separated by width of coxa. Mesosternum strongly convex externally, emargination broadly evenly U-shaped, internally strongly deeply concave; externally densely scale covered. Metasternum with moderately large deep scale clothed median depression. Abdominal sternum 1 with distinct transverse sulcus behind anterior margin, median part of sulcus V-shaped; with dense erect to suberect scales in groove; remaining area with sparse uneven punctures and scales. Sutures deep and rather broad, 1st suture weakly curved medially (to slightly emarginate), remaining sutures nearly straight. Sternum 5 trifoveate, median fovea expanded to a broad depression with hind margin subcarinate; lateral foveae very deep, ca 1/4 to 1/3 diameter of median depression.

Legs with dense white and brown recumbent to erect coarse scales; tibiae with narrow reticulate line lacking scales on entire inner margin; tarsi clothed ventrally with fine dense pubescence, 3rd segment strongly bilobed, slightly less than twice as wide as 2nd segment.

Allotype: Female. Length, pronotum and elytron, 10.6 mm. Scarcely separable externally from male. Abdominal sternum 5 with median fovea slightly smaller than lateral foveae, median area weakly depressed, all 3 foveae very deep, hind margin indistinctly raised.

Etymological note. This epithet results from the combination of 2 Latin words, *humerus* = shoulder and *dens* = tooth, which refer to the distinct humeral tooth (or tubercle) on the elytra.

Remarks with notes on variation. At hand are 52 adults, 4 pupae, 8 larvae and 9 fully developed eggs. All of the adults were reared, and 5 are incompletely developed or badly damaged so are not included in the type-series. The adults range in size from 8.8 mm. to 12.1 mm. There are minor variations in color pattern,

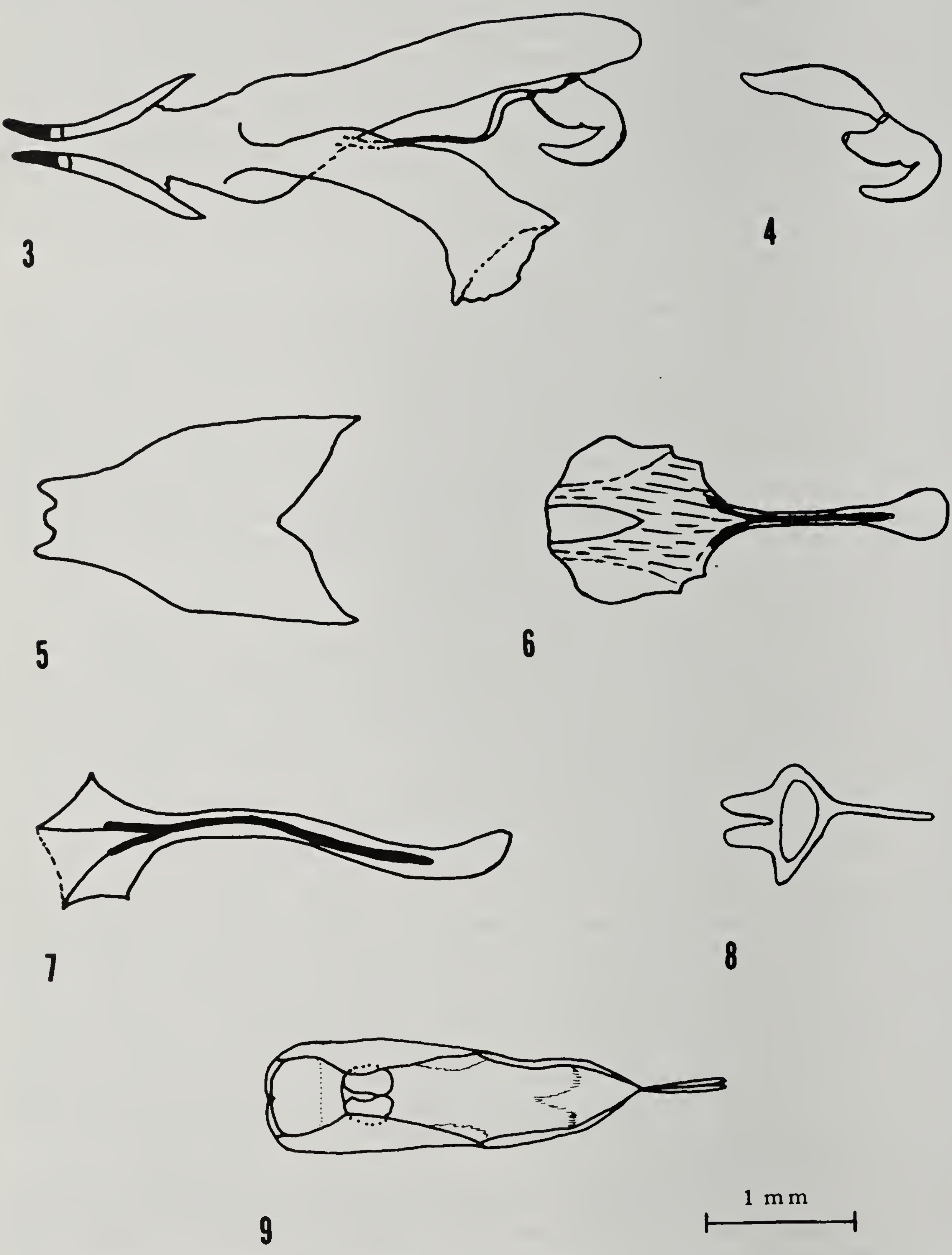

Fig. 3-9 *Eriocereophaga humeridens*: 3) dorsal view, female, ovipositor, vagina, oviduct, bursa copulatrix, spermathecal duct, spermatheca; 4) female, lateral view spermatheca, spermathecal gland; 5) female dorsal view, 8th tergite; 6) female dorsal view, 8th sternite; 7) male, dorsal view spiculum gastrale; 8) male, dorsal view, 8th sternite, ("tegmen"); 9) male, dorsal view, phallus.

but in general the specimens on hand are quite uniform. The only significant exception is in the degree of sculpture and punctation of the thoracic disc. The punctures may be dense or sparse and are found among the rugosities and/or tubercles which vary greatly in density and development. The lateral and submedian tubercles are always present but may be weakly to very strongly developed. The same is true for the median carina. The rugosities on the posterior half of the disc are especially variable in their development.

Range. Known only from northeastern Brazil, in the states of Pernambuco and Bahia. *Pernambuco*: near Arcoverde (Type-Locality); northern Pernambuco, at Paraiba borders. *Bahia*: between Juazeiro and Senhor do Bonfim; Jequie; near Riacho do Jacuipe (R. E. McFadyen, Pers. Comm.).

Material Examined. Holotype, allotype, and paratypes are deposited in the collection of the Universidade do Parana, Curitiba, Brazil. Paratypes and/or nontype material are also in the following collections: British Museum (Natural History), London, England; Commonwealth Institute of Biological Control, Curepe, Trinidad; Commonwealth Scientific and Industrial Research Organization, Canberra, Australia; Instituto Miguel Lillo, Tucuman, Argentina; Museu do Zoologia, Saõ Paulo, Brazil; Museu Nacional, Rio de Janeiro, Brazil; National Museum of Natural History, Washington, D. C.; C. W. O'Brien Collection, Florida A & M University, Tallahassee, Fl.; and E. L. Sleeper Collection, Long Beach, CA.

ACKNOWLEDGMENTS

I wish to express my sincere thanks to Dr. R. E. McFadyen (formerly Cruttwell) of the Commonwealth Institute of Biological Control for her assistance in providing information on hosts, collection data, and especially for making available essential additional specimens following her initial shipment.

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An abstract should be a concise statement of the facts presented, not *that* they are presented (e.g. list names of organisms, not just that they were discussed or described as new). These abstracts are the key to how your article will be cited in the abstracting journals and should be carefully written.

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WANTED: Carabidae *larvae.* Studying the phylogeny of the tribes Morionini, Pterostichini, Agonini, and Amarini as a thesis problem. Request loans, will sort. Contact for further information and/or send to Raymond G. Thompson, Dept. Ent., Univ. of Arkansas, Fayetteville, AR 72701. 501/575-2451.

STAPHYLINIDAE: If anyone wishes to send us unsorted Staphylinidae in 70% alcohol we will *eventually* return 1 or 2 specimens mounted, labeled and identified to the nearest possible taxon. Ecological data particularly desired. Ian Moore, Div. Biological Control, Univ. of California, Riverside, CA 92502.

SCARABAEIDAE: Studying myrmecophilous and termitophilous Aphodiinae. Request loan of New World material especially. Will sort from general scarab collections or from light trap samples. Robert E. Woodruff, Fla. Dept. Agr., P. O. Box 1269, Gainesville, FL 32601.

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EXCHANGE: Coleoptera of all Families from Arizona; ask for List and send yours. Dr. Rudolph Lenczy, 126 Los Robles, Green Valley, Arizona 85614.

LATHRIDIIDAE: Want specimens from entire world; exchange specimens, literature, and experiences. Jurgen Otto, 4006 Erkrath Kirchstr. 36—West Germany.

PUERTO RICAN COLEOPTERA: Building reference collection; need determiners (can keep duplicates). Will also exchange. Julio Micheli, 14 Baldorioty St., Mariani, Ponce, Puerto Rico 00731.

LUCANIDAE: Buy, sell, exchange all species. Also want collection data and world literature on the family. Bill E. Gavin, 981 N. W. Circle Blvd. #1, Corvallis, OR 97330.

CARABIDAE: Have *Calosoma (Carabominus) asper* Jeannel & *C. (Blapstoma) chihuahua* Gidaspow for exchange. I want *Carabus,* Cychrini, or *Calosoma* not represented in my collection. B. Rotger, Pagosa Springs, Colo. 81147.

RHYSODIDAE: Wanted, for world-wide revision. Willing to identify and return or exchange for U. S. Carabidae. Ross T. Bell, Zoology Dept., University of Vermont, Burlington, VT 05401, U.S.A.

SCARABAEIDAE: Working toward a general revision of the Anomalinae of Mexico, Central, and South America. Specimens and records needed by loan, purchase, or exchange. Identifications by arrangement. Robert W. L. Potts, California Acad. Sci., Golden Gate Park, San Francisco, CA 94118.

CHRYSOMELIDAE (ALTICINAE): Reworking manuscript revision of the maculate species of *Phyllotreta* of the U. S. and Canada for publication (includes the normally immaculate *P. denticornis. P. decipiens,* and *P. d. ordinata*). Request loan of such material immediately. Eric H. Smith, Division of Insects, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

MELOIDAE: Revising the genus *Gnathium* (Nemognathinae). Request loan of specimens from all areas, Mexican material being particularly welcome. Wilbur R. Enns, 1-87 Agriculture Building, University of Mo., Columbia, MO 65201.

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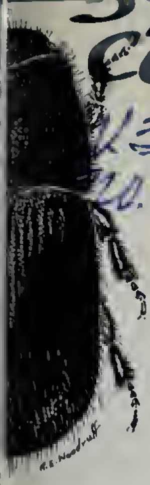

THE COLEOPTERISTS BULLETIN

AN INTERNATIONAL JOURNAL DEVOTED TO
THE STUDY OF BEETLES

Volume 30, No. 4 **December, 1976**

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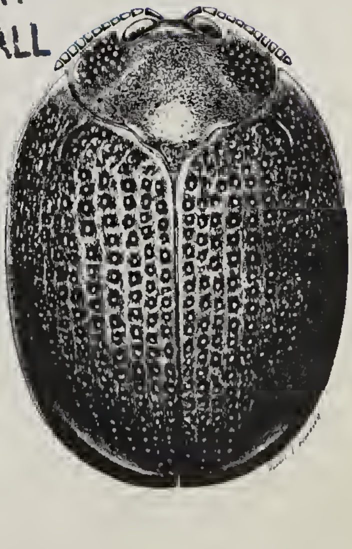

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PSAMMOPHILOUS AQUATIC BEETLES IN SOUTHERN CALIFORNIA: A STUDY OF MICROHABITAT PREFERENCES WITH NOTES ON RESPONSES TO STREAM ALTERATION (COLEOPTERA: HYDRAENIDAE AND HYDROPHILIDAE)

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Abstract

Systematic sampling of stream banks along the San Gabriel River in southern California revealed distinct zones of microhabitat preference for adults of the various genera studied (Hydraenidae: *Hydraena; Limnebius; Ochthebius*) (Hydrophilidae: *Chaetarthria; Laccobius*). Limitations on microhabitat utilization by genera appear to result from the interaction of flow rate, slope of the stream bank, size of interstitial spaces, and convexity of the beetles (among other components). Differences in zones of microhabitat utilization by congeneric species, where determined, were also related to beetle convexity and size of interstices. Extensive alterations of the psammic habitat have resulted in restriction of these beetles to the mountainous areas of the drainage system.

Publications regarding habitat preferences of aquatic beetles in the families Hydraenidae and Hydrophilidae are few and provide only short comments based upon field observations (LeConte 1861, Fall 1901, Richmond 1920, Leech 1948, Young 1954, Leech and Chandler 1956). These comments primarily concern strictly aquatic forms found in the benthic zone or amongst floating or emergent vegetation. Ecological studies on hydraenid and hydrophilid beetles found in moist sand and gravel of streambanks are lacking. This ecological zone, the psammon, is also inhabited by a diverse group of non-insectan forms, including ciliates, mites, nematodes, rotifers, and oligochaetes (Hynes 1972).

The purposes of this paper are to present the methodology and some preliminary findings regarding preferences of interracting taxa in the 2 families, and to offer possible explanations, some of a broad and general nature, for the observed distributions. In addition, the observed microhabitat preferences are used as a data base from which statements are generated regarding the effects of stream alteration upon the distributions of these insects. Finally, in hope of stimulating further work, suggestions are given for more detailed study of this problem.

Materials and Methods

The species considered here are tiny beetles which inhabit the ecotonal zone between the stream and the adjacent dry soil. In these habitats the thigmotactic beetles wedge themselves between the sand grains and pebbles and eat microscopic algae and other microorganisms growing upon the moist substratum.

Adults of these taxa are dislodged quite readily by splashing water from the stream or pond onto the shore, using the hand as a scoop. The water flows back down into the stream or pond, washing the minute beetles off the substratum and out onto the surface of the water. The ventral surfaces of these beetles have hydrofuge pubescence which holds a bubble of air used in respiration. This bubble causes the beetle to float upon the surface of the stream and, since the beetle cannot swim, permits its easy collection.

While collecting in the above manner, I observed that if water was repeatedly splashed on a small area of the streambank, a sequence of taxa would be obtained. This observation prompted the development of a simple sampling method to reveal the distribution of these psammophilous beetles within and on the sand bank. The method involves partitioning of the stream bank by using a U-shaped trough constructed of 24 gauge sheet metal. The psammophilous sampler measured 1 inch (2.54 cm) square in cross section and 13 inches in length (Fig. 1).

A psammophilous sample is taken by the following steps: (1) Forcing the inverted U-shaped sampler repeatedly into the stream bank, forming a series of parallel lines (Fig. 1); (2) forcing a knife vertically into the substratum and drawing it along the parallel lines; (3) forcing the U-shaped sampler horizontally into the stream bank (beginning at the waterline) and removing the substratum; (4) placing the subsample so removed into an appropriately labelled container; (5 and 6) repeating steps 3 and 4 until the second 1-inch "layer" is removed (or portions of that layer); and (7) removing portions of the third layer.

At the conclusion of the sampling, a small channel perpendicular to the stream is dug at the margin of the area that has been sampled. After water has flowed into the channel and reached the level of the stream, a number of vertical measurements are made (using the surface of the water in the channel as the baseline) to ascertain the slope of the stream bank.

The individual samples are then placed in a porcelain tray and water slowly added as the substratum is vigorously agitated. This dislodges the adult beetles, which float to the surface and are removed with a fine mesh nylon net and placed into appropriately labelled vials.

The results of such sampling can be graphically presented to illustrate the location of each beetle and the slope of the bank (Figs. 2, 4-7). Each subsample made by the trough is represented by 1 square "cell" on the figure (or, as the case at the waterline, portions of a "cell"). Each cell therefore represents a section of stream bank 1 inch square and 13 inches long (parallel with the stream). In the figures, "H" represents the water level of the stream, numbers along the "H" axis represent horizontal inches perpendicular to the waterline, and "V" represents vertical inches below the surface of the stream bank. The diagonal lines represent those portions of the stream bank not sampled. The English system of measurement was purposely selected so that the designation of each cell would represent its location relative to the waterline and the stream bank surface. For instance, cell H5V2 would be that area which was 4-5 horizontal inches from the waterline and 1-2 vertical inches below the surface of the stream bank.

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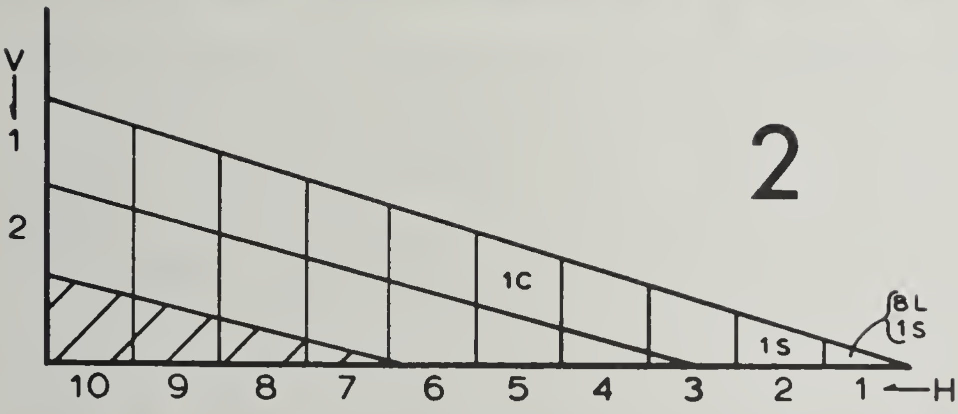

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Figs. 1-3. 1) Photograph of site of psammophilous sample no. 1 (at the beginning of the sample). Note U-shaped trough and parallel lines on stream bank. 2) Psammophilous sample no. 1 (C = *Chaetarthria,* L = *Laccobius,* S = *Ochthebius*). Numbers along the horizontal axis represent inches from the waterline. Numbers along the vertical axis represent inches below the surface of the stream bank. Each square "cell" represents a section of stream bank which is one inch square, thirteen inches long, and lies parallel to the waterline. Area with diagonal lines indicates portion of stream bank not sampled. Refer to appendix for detail of specimens collected. 3) Site of psammophilous sample no. 2 at conclusion of study.

DISCUSSION OF THE SAMPLES

Sample No. 1

The substratum of this sample (Fig. 1) consisted of homogeneous fine sand. The sand was extremely wet, as would be expected from the low slope angle of the bank (Fig. 2). The stream at this point was moving, but quite slowly. *Laccobius* preferred cell H1V1, with 8 specimens collected in that subsample and none in the remainder of the area studied. One specimen of *Ochthebius interruptus* LeConte was also found in cell H1V1. Cell H5V1 contained a single *Chaetarthria*. The sample was made in the afternoon of October, 1971.

Sample No. 2

This sample was taken at midday in the month of November, 1971, on the West Fork of the San Gabriel River (Fig. 12:2). The substratum was heterogeneous, consisting of a gradation of particle size from fine sand to 3-inch diameter stones (Fig. 3). The current was moderate. *Laccobius*, as in Sample No. 1, was again found in cell H1V1, but now in association with the hydraenids *Limnebius* and *Ochthebius* (Fig. 4). The hydraenids were found in cells H1V1-H4V1 only, with the greatest concentration in cell H1V1. The hydrophilid, *Chaetarthria*, was seen to have a decided preference for the upper regions of the stream bank, with the distribution beginning at cell H7V2 and continuing to cell H29V1. Four species of *Chaetarthria* (see appendix) were taken at this site. The only species preference noted was the distribution of *Chaetarthria pallida* (LeConte) at the region of the sample farthest from the stream.

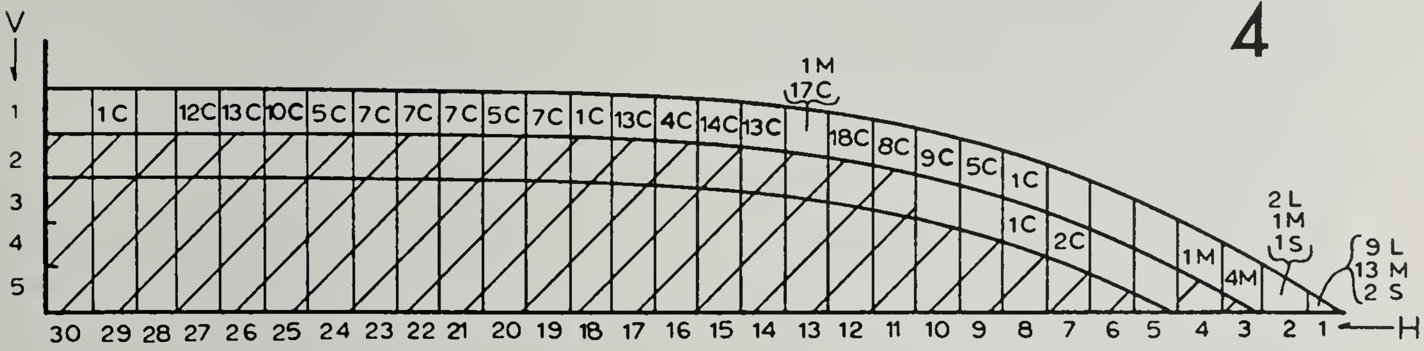
The rapid decrease in numbers of *Chaetarthria* at the upper limits of the study (Fig. 4:H28-H30) was undoubtedly due to the presence of a footpath, the edge of which was intersected by the sample (Fig. 3). The substratum at this point was very compacted, the larger particles forced downward so that the interstices separating them became tightly packed with smaller particles.

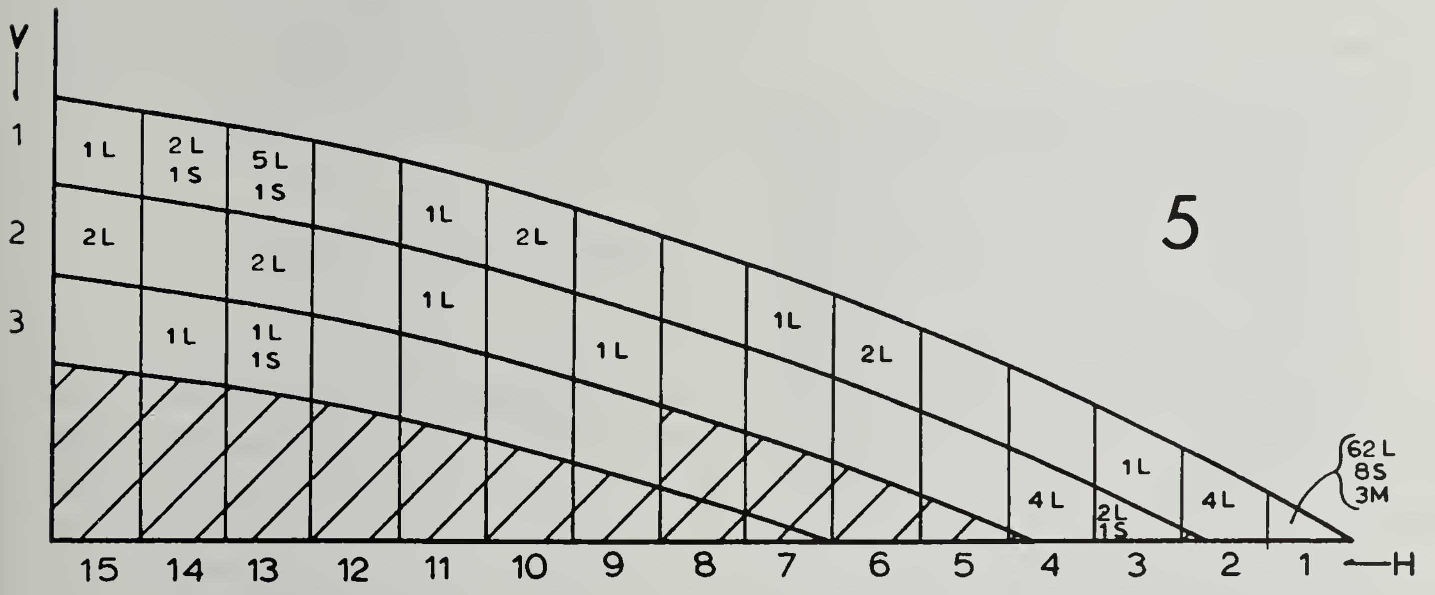
The single *Limnebius* found in cell H13V1 was a teneral adult; the location of this specimen probably reflects the region of pupation selected by *Limnebius* larvae. The larvae of *Limnebius* are semi-aquatic, and one would expect to find them in the general region utilized by *Chaetarthria*.

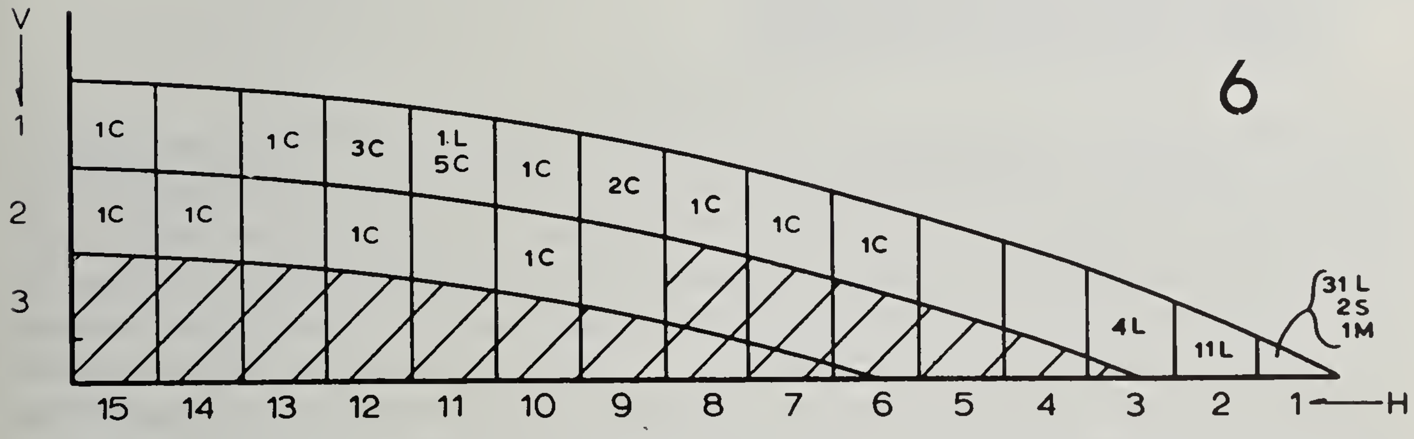
Sample No. 3

Figure 5 illustrates the distribution within a sand bank of a backwater pool (approximately 6 feet in diameter) located on the West Fork of the river (Fig. 12:2). No current was visible in the pool, and the substratum of the bank was wet and composed primarily of what might be described as homogeneous sand. By this I mean that there was very little variation in particle size within the bank. A concentration of *Laccobius,* including 4 species (see appendix), was found at the waterline (H1V1). The scattered individuals of *Laccobius* which were collected farther up the bank were observed to be moving toward the pool (on the surface of the sand). The sample was taken in the early morning (October, 1971), and it may be that this distribution reflects nocturnal activity high on the stream bank, whereas most diurnal activity takes place near the waterline.

Those specimens taken from the third vertical layer are presumably due to sampling error. This occurs when a specimen in an upper layer is exposed by removal of a sample and subsequently crawls to the next vertical layer before its true location is sampled. These beetles must obtain atmospheric air periodically, which would seem to be quite difficult from a depth of 3 inches in a substratum the interstices of which were filled with water.







Figs. 4-6, Psammophilous samples 2-4, refer to Fig. 2 and text for explanation (C = *Chaetarthria*, L = *Laccobius*, M = *Limnebius*, S = *Ochthebius*): 4) sample no. 2; 5) sample no. 3; 6) sample no. 4.

Both *Ochthebius interruptus* LeConte and *Limnebius* sp. also displayed a decided preference for cell H1V1.

Sample No. 4

This sample (Fig. 6) was taken not far from Sample No. 2 (Fig. 4). The substratum, however, consisted of homogeneous sand. The flow rate of the stream was slow. Although *Chaetarthria* was present in its typical distribution pattern, a much larger proportion of the specimens were *C. pallida*. *Laccobius* again displayed its preference for cell H1V1, where it was taken in association with 2 *Ochthebius* and only 1 *Limnebius*.

Sample No. 5

This sample (Fig. 7) was taken on the West Fork at an elevation of 3100 feet (Fig. 12:1) in November, 1971. The substratum was heterogeneous (fine sand to 1/4 inch diameter pebbles), and the flow rate was moderate (Fig. 8). The area was extremely productive, with a total of 307 beetles collected. The hydraenids *Limnebius* and *Hydraena* predominated at the waterline, with the preferred cell being H3V1. *Chaetarthria* again was seen to be characteristically distributed up the stream bank, but in this instance in association with *Ochthebius puncticollis* LeConte. At the upper limits of the sample (Fig. 7:H36V1), the roots of a tree were encountered. The particles exhibited a gradation of size from pebbles at the surface to very fine grains at 3 inches below the surface (Fig. 9).

RESULTS IN TERMS OF THE GENERA

Laccobius

Psammophilous sampling revealed that members of this genus in the study area occupied a distinct zone on the stream bank. Differences in habitat preferences among the 4 species, however, were not determined. The distribution preference in Sample No. 3 was dramatic, with 62 individuals, including representatives of all 4 species, present in the first inch of substratum (Fig. 5:H1V1), and only scattered individuals present above that zone. The other sampling studies revealed similar distributions. A decrease in number of individuals, however, was seen in studies of banks that bordered flowing water. In these situations, the adults of *Limnebius* and *Hydraena* would predominate.

Chaetarthria

All 5 species of *Chaetarthria* found in the San Gabriel River occupied a distinct zone of preference within the stream bank. This zone began at a distance approximately 5 inches from the waterline and extended as much as 36 inches up the bank. Most specimens were taken in the upper inch of substratum. This zone was the area of stream bank which had undergone sorting of particles, resulting in a gradation of particle size. Upper limits of distribution were caused, I assume, by the lack of appropriate interstitial spaces due to the absence of particle sorting processes. A related phenomenon with respect to habitat has been seen in the dryopoid aquatic beetle, *Psephenus* (Murvosh 1971).

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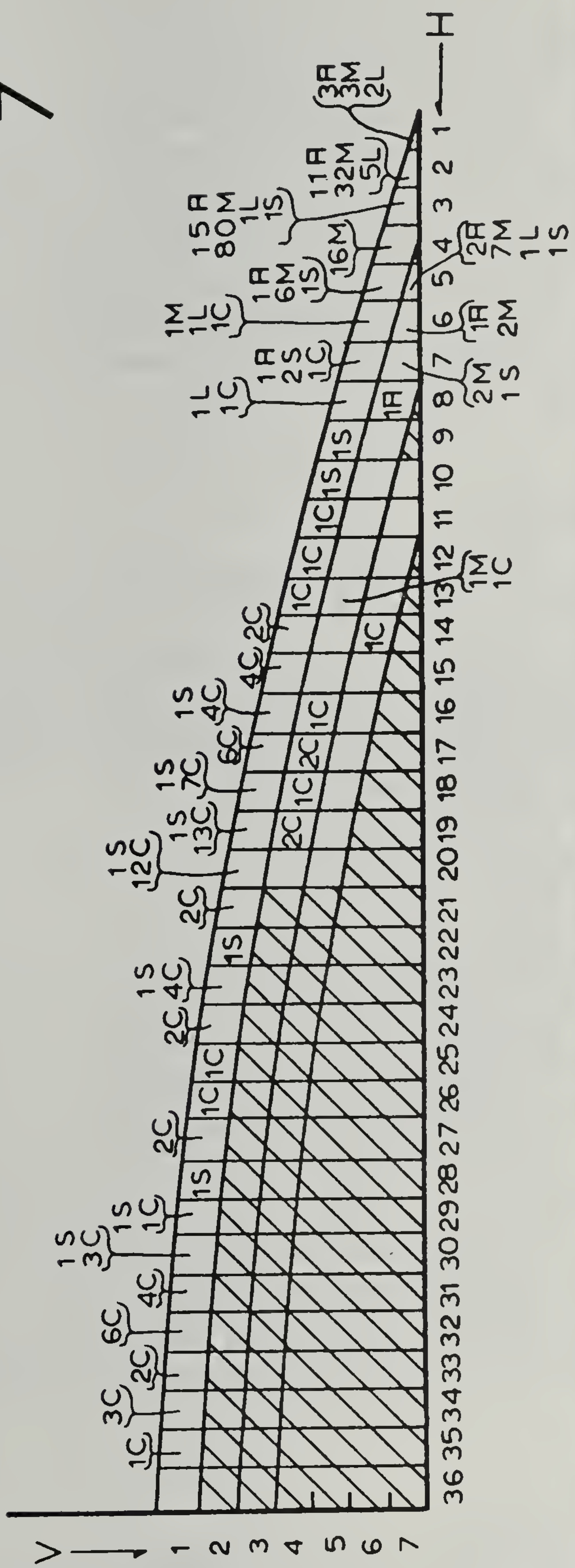

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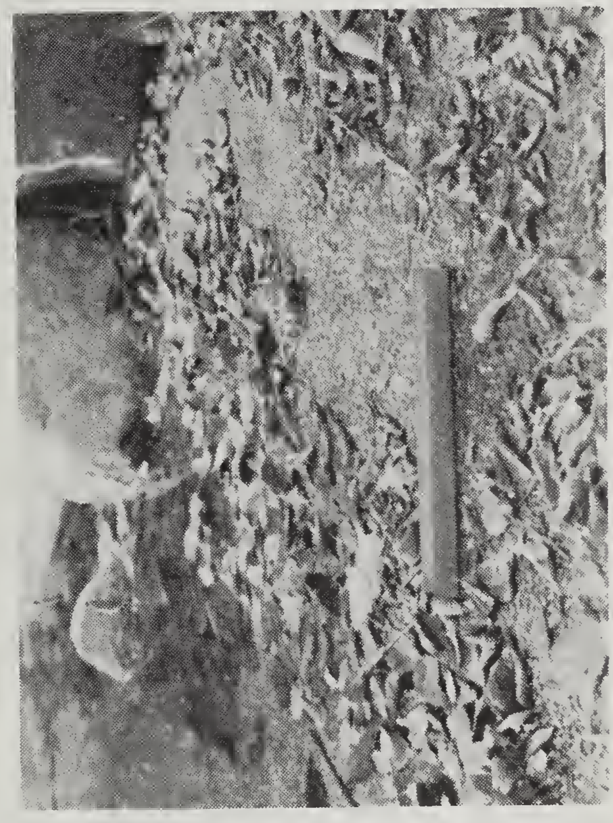

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Figs. 7-9, Psammophilous sample no. 5: 7) graphic representation of distributions and slope of bank, refer to Fig. 2 and text for explanation and to appendix for detail of specimens (C = *Chaetarthria*, L = *Laccobius*, M = *Limnebius*, S = *Ochthebius*, A = *Hydraena*); 8) photograph of site before sampling (leaves were removed before sampling was initiated); 9) photograph of the margin of the sample at the conclusion of substratum removal (note the gradation of particle size, from pebbles at the surface to fine sand grains at three inches below the surface).

Exact microhabitats of the separate species of *Chaetarthria* were not determined; certain trends, however, were noted. The species *C. pallida* was encountered in increasing numbers at the upper limits of the zone of preference for the genus. This was the only species of the genus taken at Whittier Narrows (Fig. 12:11). The habitat at that locality consisted of the margin of a man-made lake. Water movement was not present in the lake, and the shore was composed of fine sand. Beetles which were dislodged by splashing water on the bank were observed to crawl rapidly back up the bank and begin to burrow into the sand at a distance slightly less than a yard from the waterline. I consider it significant that *C. pallida* was the smallest member of the genus collected in the study area, and also the species that occupied the area with the smallest interstices (Fig. 10b). Leech (1948) reported that species of this genus are nocturnal.

Ochthebius

Ochthebius interruptus LeConte, *O. discretus* LeConte, and *O. lineatus* LeConte preferred cells H1V1 and H2V1 (Figs. 2, 4, 5, 6). *O. puncticollis* LeConte, however, was encountered as much as 30 inches from the waterline and was more or less evenly distributed up the stream bank (Fig. 7). In this sample, as in all other samples, *Ochthebius*, regardless of species, overwhelmingly preferred the uppermost inch of substratum.

Hydraena

Hydraena sp. found in the San Gabriel River displayed a very definite preferred zone of activity within and on the stream bank (Fig. 7). The preferred zone of activity for adults, as indicated by the total number of individuals collected, was H2V1 and H3V1. This zone, in Sample No. 5 (Fig. 7), contained 26 specimens, while the number of specimens decreased drastically on either side of that zone. Specimens of the genus were not encountered beyond approximately 8 horizontal inches from the waterline. The reasons for the upper limit were not determined, but it is presumed that wetness of the substratum is an important factor. This explanation is corroborated by the fact that the zone of activity of the hydrophilid *Chaetarthria*, which was collected in moist, but not wet situations, began 2 inches above the upper limits of *Hydraena* sp.

Limnebius

Limnebius found in the San Gabriel River preferred the area of the stream bank approximately 1 inch to 3 inches from the waterline. The adults also preferred the margin of a stream where the water was flowing, instead of a backwater pool where there was little or no current. This is demonstrated by a comparison between Figs. 5 and 7. In Fig. 5, only 3 specimens were collected in the total sample, whereas in Fig. 7, 80 specimens were collected in the single cell H3V1. The preference of the area 1 inch to 3 inches from the waterline is graphically represented in Fig. 7, where 112 specimens were collected in that area, whereas only 38 specimens were collected outside that area. As in the genera *Ochthebius* and *Hydraena*, the uppermost inch of substratum was preferred.

INTERPRETATIONS AND GENERAL CONSIDERATIONS

Habitat preferences of certain genera, and in some instances species, seem to be closely correlated with the interstitial space size of the substratum. The size of interstices is, of course, a reflection of the particle size. That is, the larger the particles, the greater the size of interstices, and conversely, the smaller the particles the smaller the interstices.

The interstices used by these beetles must be relatively devoid of silt, which would fill the cavities and prevent both food-getting and respiration. The lack of interstices appears to be the logical explanation for the vertical limits on the distribution of the various genera studied here. I assume that precipitation and water splashing from the stream onto the bank cause the smaller particles to be washed downward, thereby sorting the particles by size, with consequent formation of interstices in the upper inches.

The horizontal distribution (distance from the waterline) appears to result from the interaction of a number of factors, including size of interstices, convexity and hydrophilic preferences of the beetles, flow rate of the stream, and slope of the bank (which partly determines the amount of moisture present).

The preferred location of the beetle genera within the stream bank displayed a direct correlation between size of interstices and convexity of the beetles (Fig. 10). *Chaetarthria*, which has been shown to prefer the area with greatest size of interstices, is the most convex beetle in the study area (Fig. 10 a and b). This genus has the ability to partly roll into a ball, undoubtedly a defense against predation. The most convex hydraenid, *Ochthebius*

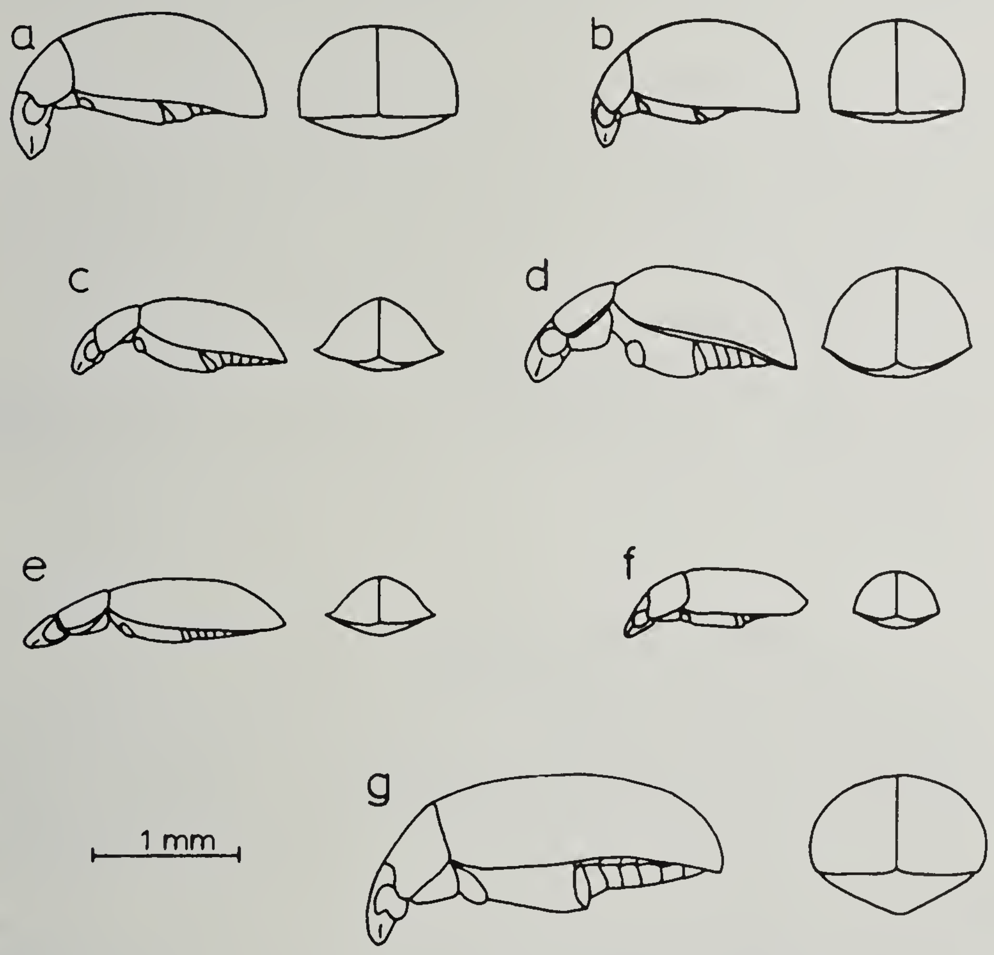

Fig. 10. Lateral and posterior views of psammophilous aquatic beetles (a = *Chaetarthria nigrella*, b = *Chaetarthria pallida*, c = *Ochthebius interruptus*, d = *Ochthebius puncticollis*, e = *Hydraena* sp., f = *Limnebius* sp., g = *Laccobius californicus*).

puncticollis (Fig. 10 d), also occupied the area with the greatest size of interstices. Convexity, in the area close to the waterline, would be a limiting factor due to the resistance it creates against flowing water. *Hydraena* and *Limnebius* (Fig. 10 e and f), which are extremely flattened, occupy this zone if the flow rate is moderate.

Laccobius appears to generally displace *Limnebius* in areas of slow flow rate, and conversely, *Limnebius* appears to be more adapted to areas of fast flow rate than *Laccobius* (Fig. 11). The small size of *Limnebius* would allow them to utilize smaller submerged interstices in cell H3V1 in areas of moderately fast water. This would allow them to seek refuge beneath the surface of the substratum in times of rapid rise in stream level due to precipitation. Their relatively flattened form would also be an aid to withstanding the pressures of flowing water. However, as Fig. 11 illustrates, the peak of utilization lies between 2 and 3 inches from the waterline, indicating perhaps that flow rate at the waterline is a limiting factor for *Limnebius*.

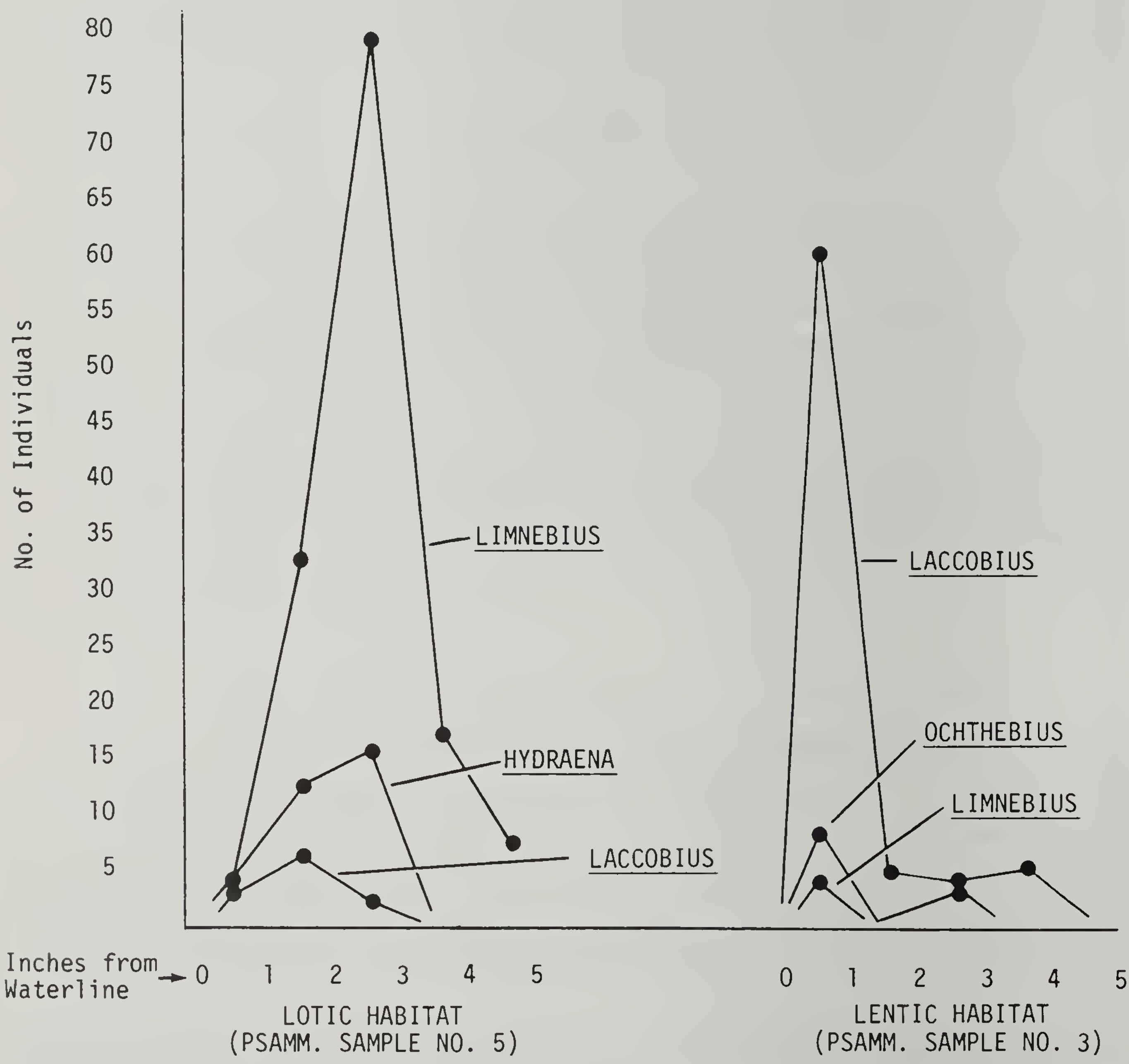

Fig. 11. Effects of flow rate on Coleopterous components of the psammic zone.

Laccobius, on the other hand, is much larger and would be unable to seek refuge between particles to the extent that *Limnebius* does. Also, their convex body form (Fig. 10g) would present much more resistance to the flowing water.

Laccobius is a very weak swimmer, and this would allow the species to more effectively utilize the area at and just slightly below the waterline (in areas of slow or non-existent flow rate). *Limnebius*, being unable to swim, would need substratum to reach the surface to obtain atmospheric air for respiration. This would restrict their use of the area immediately below the waterline.

However, this does not explain the absence of *Limnebius* in cell H3V1 of Samples No. 1, 3, and 4. One major difference between the substratum of those samples and that of the samples which did contain *Limnebius* in cell H3V1 was that the interstices of the former samples were filled with water, whereas those of the latter were not. Perhaps this indicates that the lack of air-filled interstices is an important limiting factor for *Limnebius*.

The degree of water saturation of the psammic zone is intimately interrelated with the slope and permanence of the stream bank. Relatively saturated banks generally have a much lower slope angle and are much more frequently being washed downstream and redeposited, whereas relatively unsaturated banks are generally much more permanent and have a higher slope angle. The frequent mixing of particles in the relatively saturated and impermanent banks results in more uniform particle size and prevents any vertical sorting of particles. Relatively permanent banks, however, do not have the particles mixed frequently and the banks are high enough above the water level of the stream to allow percolation of rain water and water splashing from the stream, with the consequent sorting of particles.

It would appear then that physical limiting factors acting upon the adults, rather than competition, are the primary causes of the observed distributions of these 2 genera. However, it should be noted that the *larvae* of the hydraenids are only semi-aquatic and require some degree of air-filled interstitial space for feeding and protection from predators. The *larvae of Laccobius*, on the other hand, are totally aquatic and predaceous, living near the waterline. The adult hydraenids oviposit in this area, and the newly emerged larvae remain for a short time beneath the water. They would, therefore, be in an excellent position for predation by *Laccobius* larvae.

Effects of Habitat Alteration

The San Gabriel River in southern California (Fig 12) proved to be an excellent site for this study, not only because of the abundance of these psammophilous forms, but also because the river has received considerable alteration in certain regions.

Young (1954) stated that populations of aquatic Coleoptera are not directly correlated with the volume of water present in an aquatic situation, but with the extent of suitable shoreline. Most aquatic Coleoptera of the families Hydraenidae and Hydrophilidae collected in this study were found to require a more or less permanent shoreline composed of sand, pebbles, and stones.

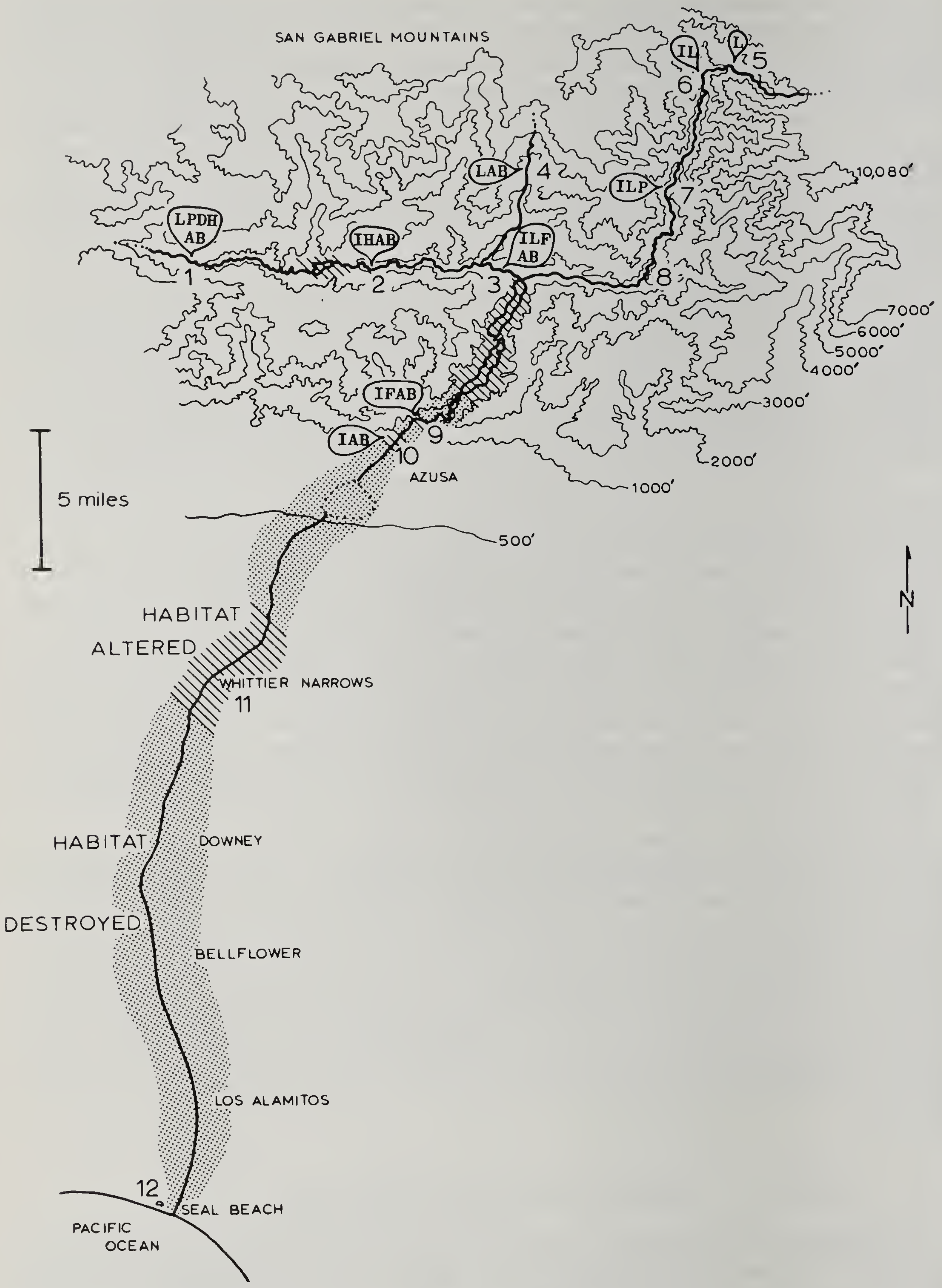

Fig. 12. San Gabriel River and distribution of the Hydraenidae (I = *Ochthebius interruptus*, L = *Ochthebius lineatus*, P = *Ochthebius puncticollis*, F = *Ochthebius costipennis*, D = *Ochthebius discretus*, H = *Hydraena* sp., A = *Limnebius* sp. A, B = *Limnebius* sp. B).

13

14

15

Figs. 13-15, San Gabriel River: 13) West Fork in the San Gabriel Mountains; 14) vicinity of Whittier Narrows (note mounds of sand made by bulldozers); 15) vicinity of Bellflower.

A combination of many different types of alteration has destroyed the aquatic Coleoptera habitats of what was previously the lower river. From the Pacific Ocean northward to just south of Los Alamitos, the "river" is a channel with sides composed of granite blocks. From Los Alamitos to just south of Whittier Narrows, the channel is completely cement (Fig. 15). Collecting in the channel did not provide a single specimen for this study, and the area can only be designated "destroyed habitat" relative to the insects in question.

In the vicinity of Whittier also, the San Gabriel River is in a disturbed condition. The "banks" of the river in this region are composed of cement-covered granite blocks, or cement-covered soil. In portions of this area, presumably to facilitate percolation, bulldozers are used to move the substratum in the riverbed from one location to another (Fig. 14). This movement completely destroys the habitats of the psammophilous forms. Species which prefer lentic situations were less influenced by this action. However, portions of the river in this area would be without water for periods of time, presumably due to controls on the upper river. The adult beetles in this study could survive short periods without water, since they are able to fly to other aquatic habitats. The larvae, on the other hand, are flightless and require moisture to prevent desiccation. For these reasons, I designate as "altered habitat" the river in the vicinity of Whittier Narrows.

From just north of the Whittier Narrows area to the base of the San Gabriel Mountains, only 2 extremely small areas had water (in 1972). These areas are designated as 9 and 10 in Fig. 12. The presence of beetles in these areas corroborates the idea that the absence of beetles in the lower portions of the river is not a reflection of altitudinal limitations on distribution.

Most of that part of the river which flows through the San Gabriel Mountains is in a much less altered state (Fig. 13). Alteration of stream habitat, however, has been caused by damming the gorges to form reservoirs. The water level in the reservoirs is high on the sides of the gorge, where there has been little erosive activity. It is well known that erosive activity is one of the major formative agents of the riparian habitat. There are, therefore, suitable habitats for only the most vagile species. Collecting at 1 of the 3 reservoirs, Cogswell Reservoir (Fig. 12: just upstream from 2), revealed only a few specimens of the hydrophilid genus *Laccobius*. Contrastingly, specimens of all 3 genera of Hydraenidae, and the hydrophilid genera *Laccobius*, *Chaetarthria*, *Enochrus*, and *Tropisternus* were collected in numbers approximately 1 mile downstream from the dam. In light of this, the reservoirs are designated altered habitat.

SUGGESTIONS FOR FUTURE STUDY

The results and interpretations presented here, for the most part, are of a descriptive and general nature. Hopefully they have clarified some of the problems and will serve to stimulate further research in this area. Many components of the psammic zone need more precise elucidation, and perhaps future study might include some of the following techniques and topics: (1) measurements of particle size and water content of the various subsamples; (2) detailed recordings of fluctuations in stream level and the resultant modifications in beetle microhabitat distributions; (3) precise measurements of flow rate; (4) the sequence of recolonization that occurs following torrential flooding; (5) limiting factors acting upon 2 or more congeneric species which have adults of very similar size and shape; (6) to what degree environmental pressures acting upon the larval stages of these insects affect the observed distributions of the adult stages; (7) what species in the past, if any, would have been found in greater numbers in the lower portion of the drainage basin than in the mountainous regions, and what effects their invasion of the mountain psammic habitats would have on taxon interactions.

Acknowledgements

I am indebted to Brian S. Cheary and David C. Miller for determinations of representatives of the genera *Laccobius* and *Chaetarthria,* respectively. My sincere appreciation also to Paul J. Spangler for assistance with the manuscript.

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Appendix

The following species of hydraenids and hydrophilids were found in samples 1, 2, 4, and 5. The alphabetical designations are those used in the detail of specimens:

A. *Limnebius* sp.
B. *Hydraena* sp.
C. *Ochthebius discretus* LeConte
D. *Ochthebius interruptus* LeConte
E. *Ochthebius lineatus* LeConte
F. *Ochthebius puncticollis* LeConte
G. *Laccobius californicus* d'Orchymont
H. *Laccobius carri* d'Orchymont
I. *Laccobius ellipticus* LeConte
J. *Laccobius piceus* Fall
K. *Chaetarthria bicolor* Sharp
L. *Chaetarthria hespera* Miller
M. *Chaetarthria nigrella* (LeConte)
N. *Chaetarthria ochra* Miller
O. *Chaetarthria pallida* (LeConte)

The following lists present the sample number, cell number (subsample location), species, number of individuals, and sex of the specimens collected in samples 1, 2, 4, and 5. The lists are divided into 2 major sections, the first giving data on hydraenids and hydrophilids, the second on other Coleoptera which were present in the samples. The figures in parentheses indicate the number of each sex collected, with the first entry being the number of males. Preceding the parenthetical entry is an alphabetical designation which corresponds to the species present (see above list). (Note: females of *Chaetarthria hespera* and *C. nigrella* cannot be differentiated, therefore the alphabetical entry reads "L or M"; likewise, *Laccobius californicus* and *L. ellipticus* females cannot be differentiated and are therefore given as "G or I".)

HYDRAENIDAE AND HYDROPHILIDAE

Sample No. 1: *H1V1*-J(3/4), G or I(0/1), D(0/1). *H2V1*-C(0/1). *H5V1*-L or M(0/1).

Sample No. 2: *H1V1*-J(4/3), H(2/0), A(8/5), D(1/0), E(1/0). *H2V1*-J(2/0), A(1/0), E(1/0). *H3V1*-A(2/2). *H4V1*-A(0/1). *H8V1*-K(0/1). *H9V1*-K(1/0), L(2/2). *H10V1*-K(1/0), L(3/5). *H11V1*-K(2/1), L(1/2), N(2/0). *H12V1*-K(1/6), L(8/2), N(0/1). *H13V1*-A(1/0), K(4/5), L(4/4). *H14V1*-K(5/5), L(2/1). *H15V1*-K(5/4), L(3/1), N(0/1). *H16V1*-K(1/2), L(0/1). *H17V1*-K(3/5), L(2/3). *H18V1*-K(1/0). *H19V1*-K(2/3), L(0/2). *H20V1*-K(1/2), L(0/2). *H21V1*-K(2/3), L(0/2). *H22V1*-K(3/1), L(1/1), N(1/0). *H23V1*-K(4/1), L(0/2). *H24V1*-K(0/4), L(1/2). *H25V1*-K(4/1), L(1/2), O(2/0). *H26V1*-K(5/3), L(2/2), O(0/1). *H27V1*-K(4/2), L(2/2), O(0/2). *H29V1*-L(0/1). *H7V2*-L(1/1). *H8V2*-L(1/0).

Sample No. 4: *H1V1*-H(2/2), J(5/5), G(4/0), I(3/0), G or I(0/10), A(0/1), E(0/2). *H2V1*-H(0/2), J(3/4), G or I(0/2). *H3V1*-J(2/2). *H6V1*-L(1/0). *H7V1*L(1/0). *H8V1*-L(1/0). *H9V1*-L(1/0), O(0/1). *H10V1*-K(1/0). *H11V1*-K(2/0), N(1/0), O(1/1), J(0/1). *H12V1*-K(1/1), O(0/1). *H13V1*-K(0/1). *H15V1*-O(1/0). *H10V2*-K(0/1). *H12V2*-O(1/0). *H14V2*-O(1/0). *H15V2*-O(1/0).

Sample No. 5: *H1V1*-B(1/2), A(1/2), G(1/0), G or I(0/1). *H2V1*-B(7/4), A(17/15), G(3/0), G or I(0/2). *H3V1*-B(9/6), A(45/35), G or I(0/1), F(1/0). *H4V1*-A(8/8). *H5V1*-A(5/1), B(0/1), F(1/0). *H6V1*-A(1/0), J(1/0), L or M(0/1). *H7V1*-B(0/1), F(1/1), L or M(0/1). *H8V1*-J(1/0), L(1/0). *H9V1*-F(1/0). *H10V1*-F(1/0). *H11V1*-L(1/0). *H12V1*-L (1/0). *H13V1*-L or M(0/1). *H14V1*-L or M(0/2). *H15V1*-L(2/0), L or M(0/2). *H16V1*-L (1/0), M(1/0), L or M(0/2), F(0/1). *H17V1*-L(2/0), L or M (0/4). *H18V1*-L(1/0), L or M(0/6), F(0/1). *H19V1*-L(2/0), L or M(0/10), K(1/0), F(0/1). *H20V1*-L(5/0), L or M (0/6), M(1/0), F(0/1). *H21V1*-L(2/0). *H22V1*-F(0/1). *H23V1*-L(2/0), L or M(0/2), F (1/0). *H24V1*-L(1/0), L or M(0/1). *H25V1*-L(1/0). *H26V1*-L or M(0/1). *H27V1*-L or M(0/2). *H28V1*-F(1/0). *H29V1*-M(1/0), F(0/1). *H30V1*-L(3/0), F(0/1). *H31V1*-L(4/0). *H32V1*-L(1/0), L or M(0/5). *H33V1*-L(1/0), M(1/0). *H34V1*-L(2/0), L or M(0/1). *H35V1*-L or M(0/1). *H5V2*-B(2/0), A(4/3), G or I(0/1), F(1/0). *H6V2*-B(1/0), A(1/1). *H7V2*-A(1/1), F(1/0). *H8V2*-B(0/1). *H13V2*-A(0/1), L(1/0). *H16V2*-M(1/0). *H17V2*-L (1/0), M(1/0). *H18V2*-L(1/0). *H19V2*-L(1/0), M(1/0). *H14V3*-L or M(0/1).

OTHER COLEOPTERA

Sample No. 2: H2V1-Staphylinidae (1 larva). H15V1-Sphaeriidae (5 adults). H20V1-*Limnichus californicus* (1 adult). H25V1-Sphaeriidae (2 adults). H26V1-*Omophron dentatus* (1 adult), Sphaeriidae (1 adult). H9V2-Staphylinidae (1 larva).

Sample No. 4: H3V1-*Heterocerus* sp. (1 adult). H8V1-Carabidae (1 adult). H10V1-Staphylinidae (2 adults).

Sample No. 5: H4V1-Helodidae (1 larva). H9V1-Staphylinidae (2 adults). H11V1-Staphylinidae (1 adult). H33V1-Staphylinidae (1 larva). H11V2-Chrysomelidae (1 adult). H14V2-Staphylinidae (1 larva).

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NOTES ON THE SYNONYMY OF *SCAPHINOTUS KLAHOWYAE* PERRAULT, 1973, WITH *S. JOHNSONI* VAN DYKE, 1924 (COLEOPTERA: CARABIDAE)[1]

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Abstract

Scaphinotus klahowyae Perrault (1973) is shown to be conspecific with *S. johnsoni* Van Dyke (1924), and the names are synonymized. Characters likely to cause confusion in comparing Perrault's description with other accounts of the species (elytral striae, male median lobe, pronotum, prosternal process, and color) are discussed. Perrault's combination of the subgenus *Brennus* with *Stenocantharus* is unwarranted. His characterization of the habitat at Klahowya, Washington, as "rain forest" is technically incorrect.

Scaphinotus (Brennus) johnsoni was described by Van Dyke (1924) from a single specimen collected in the Olympic Mountains of Washington, and in the next 20 years he was able to study only 3 additional specimens. He wrote a second account (Van Dyke 1944) in which he stressed the resemblance of this species to the larger *S.* (*Stenocantharus*) *angusticollis* (Mannerheim), a ubiquitous carabid occurring in the same habitat. *S. johnsoni* is still extremely rare in collections, but descriptions and/or discussions of it are included in Hatch (1953), Lindroth (1961), and Gidaspow (1968). The latter two authors also remarked on its strong resemblance to the distinctive and easily recognized *S. angusticollis*, enabling the smaller *S. johnsoni* to be readily distinguished from other northwestern cychrines.

Perrault (1973) recently described *Scaphinotus klahowyae* from 4 specimens collected by him on the Olympic Peninsula, Washington. Although he noted that these specimens were first thought to be *S. johnsoni* and that *S. klahowyae* was evidently closely related to *S. johnsoni*, he gave no indication of actually examining representatives of that species, relying instead on published descriptions. His chief basis for distinguishing *S. klahowyae* was its elytral striae, an inconstant character in many cychrines which has caused confusion in the past (Greene 1975). The only pair of comparative figures in his paper juxtaposed an illustration of the pronotum of *S. klahowyae* with that of *S. angusticollis*, rather than the more logical comparison with *S. johnsoni*.

In early April, 1975, I visited Perrault's type locality, Klahowya, a campground on U. S. Highway 101 which does not appear on many Washington road maps. It is 9.5 miles W of Fairholm and 8 miles E of Sappho. Five specimens of the form in question were collected and were compared with a paratype of *S. klahowyae* (USNM), the type of *S. johnsoni* (CAS), and 6 examples from other locations on the Olympic Peninsula: 7 miles N of Forks (1, AMNH), determined as *S. johnsoni* by Darlington; "N Olympic Mts." (1, AMNH), Ozette (2,USNM), and Toleak Point (1, USNM), all determined by Gidaspow; and ca. 4 miles W of Klahowya (1, Loren Russell collection). Perrault's description of *S. klahowyae* (with several minor exceptions) applies equally well to all 13 specimens. The variation between all specimens is either comparable to or less than that exhibited by most other northwestern cychrines. I therefore believe that *S. klahowyae* is conspecific with *S. johnsoni* and that the name should be considered a synonym of *S. johnsoni* (**New Synonymy**).

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Following are brief discussions of the characters likely to cause confusion in comparing Perrault's description with other accounts of *S. johnsoni.*

Elytral striae. Perrault (1973) stated "The elytral sculpture [of *S. johnsoni*] was described by Lindroth (1961), and Gidaspow (1968) as similar to that of *S.* [*angusticollis*] *olympiae*, the main differentiating feature being the length of the labrum. To the contrary, my specimens have very distinct, fine and regular striae though not so regular on the side of the elytra." In his key to several *Scaphinotus* spp. found on the Olympic Peninsula, *S. klahowyae* is distinguished by "Striae very distinct, fine and regular, easy to count" whereas *S. angusticollis* and *S. johnsoni* are lumped together under "Striae shallow, difficult to count." Perrault's impression of the elytral striae of *S. johnsoni* is one indication that he must not have examined an actual determined specimen. The striae are very distinct, often regular, and quite easy to count in most specimens, much more so than in *S. angusticollis.* Furthermore, there are several references to distinct striae in the literature. Gidaspow (1968) noted that the striae of *S. johnsoni* are "very much as in *angusticollis*," but went on to say that the latter species has "less-impressed, more irregular elytral striae" than *S. johnsoni.* Van Dyke (1944) stated that "the striae in *johnsoni* are . . . more distinctly and deeply impressed" than in *S. angusticollis.* Perrault was evidently influenced by Lindroth's (1961) key in which both species are characterized as having "shallow" striae, which is true in comparison with many other *Scaphinotus* spp.

Most specimens of *S. johnsoni* examined by me have similar striae, although some have fairly distinct variations. Gidaspow's (1968, figs. 56, 60) illustrations of elytra from 2 specimens, including the type, give an indication of the range. Three of my specimens from Klahowya, 2 intact pairs of elytra collected there at the same time, 3 specimens from other locations on the Olympic Peninsula, and the paratype of *S. klahowyae* have the striae "fine and regular" over most of the disk, as Perrault described. Most authors have characterized these striae as "punctate", although Hatch's (1953) "coarsely crenate" is probably more accurate for most specimens. Two specimens from Klahowya and 4 from other locations on the Peninsula have from 2 or 3 to most of the striae either incomplete and quite irregular, or fairly straight but interrupted, actually formed by a series of elongate punctures. This irregularity is usually more pronounced towards the sides and apices of the elytra. One specimen from Ozette has striae noticeably shallower than in other examples, although still more deeply impressed than in most specimens of *S. angusticollis.*

Ten of the specimens examined, including the paratype of *S. klahowyae*, all my examples from Klahowya (in addition to the 2 elytral pairs) and Van Dyke's type, have 19 striae; the other 3 have 18 striae. There may be 20 striae in some specimens (Gidaspow 1968).

Male median lobe. Perrault's (1973, fig. 6) lateral view of the median lobe of his lone male specimen corresponds quite well to Gidaspow's (1968, fig. 108) drawing. However, the dilation in the apical half as shown in his dorsal sketch (fig. 5) differs from Gidaspow's (fig. 109) rendition. Perrault was apparently unaware that in *Brennus* the median lobe can vary considerably within a species, from both lateral and dorsal aspects. Gidaspow's outlines (figs. 100-136) in her revision of the group are instructive in this regard.

Seven of the specimens studied, including all those I collected at Klahowya, are males. Their genitalia all resemble Gidaspow's and Perrault's lateral diagrams, but dorsally most correspond to Gidaspow's illustration. The median lobe of one Klahowya specimen has a dilation almost as pronounced as Perrault showed, but occurring closer to the apex.

Pronotum. Gidaspow's (1968, fig. 81) illustration of the pronotum of *S. johnsoni* is slightly misleading in several aspects; Perrault's (1973, fig. 1) outline is generally more accurate. The anterior pronotal margin on all specimens examined is much wider than Gidaspow has shown. It may be slightly curved mesad as Perrault has drawn it, or straight as in Gidaspow's figure. No specimen has the lateral margins as broadly rounded as Gidaspow showed them; Perrault's outline is extremely accurate as to the fairly sharp curve which occurs slightly closer to the anterior margin than in Gidaspow's figure. Gidaspow's shading of the disk puts a little too much emphasis on the lateral longitudinal impressions—they are usually deep where they arise from the posterior transverse impression, as Perrault has indicated, but often become quite indistinct over most of their length and may not be continuous. However, Perrault's failure to illustrate the lateral longitudinal impressions for most of their length and his use of simple lines to indicate the anterior and posterior transverse and median longitudinal impressions may also be a source of some confusion.

Pronotal form and sculpturing within other *Brennus* spp. sometimes vary considerably (Gidaspow 1968, figs. 73-99). These characters in *S. johnsoni* (=*S. klahowyae*) are quite constant in the specimens examined.

Prosternal process. The paratype of *S. klahowyae* examined had been glued to a piece of card, and thus could not be inspected ventrally. However, the prosternal process is basically similar in most specimens of *S. johnsoni*. Gidaspow's (1968, fig. 54) and Perrault's (1973, fig. 4) renditions appear so different because the former elected to emphasize the lateral lobes whereas the latter favored the fovea between them. This fovea is nearly non-existent in some specimens, more pronounced in others; it is a simple depression, or bifurcate as in Perrault's drawing. The lateral areas are strongly or weakly convex or even slightly depressed, spherical or quite irregular. One teneral specimen examined has 2 spherical lobes which had darkened more rapidly than the surrounding cuticle, and stand out as strongly as in Gidaspow's figure. In most specimens, however, the apparent form of the sculpturing changes to some extent with the angle of illumination. My specimens from Klahowya are varied as much as are individuals collected at other locations on the Peninsula.

Color. Hatch (1953) described the elytra of *S. johnsoni* as "black or chocolate brown or violet . . . at times with metallic green margins." Those specimens examined which could be called "chocolate brown" (as Van Dyke described his type) or "reddish brown" (Gidaspow 1968) are teneral. I have shown that the elytra of some *Scaphinotus* spp. retain a noticeably lighter color for about 5 weeks after eclosion (Greene 1975). Since this is usually a period of high locomotor activity, it is not surprising that some *S. johnsoni* collected should exhibit this brownish hue. Four of my specimens from Klahowya have the violet elytra Perrault described, the fifth is black with a strong violet luster. The specimen from 4 miles W of the campground and the one from ca. 12 miles W (7 miles N of Forks) both appear almost flat black when viewed with either an AO single-head or Roxter dual-head high intensity lamp, but have a violet luster in natural or fluorescent light. Specimens from Klahowya tend to have a slightly more brilliant blue-green color in the marginal groove than the other specimens examined. However, upon softening in a relaxing jar, small amounts of grease rising to the surface obscured much of the original elytral color in my Klahowya individuals, dulling the margins and turning the disks black.

SUBGENERA *Brennus* and *Stenocantharus*

Perrault (1973) also combined the subgenus *Brennus* with *Stenocantharus*, stating "I believe that the differences given between those 2 subgenera, when compared with the similarity of the 3 species [*S. klahowyae*, *S. johnsoni*, and *S. angusticollis*] within the species group defined above, do not justify keeping them distinct." Gidaspow (1968, 1973), who has worked extensively with cychrines, does not agree. In a discussion of cychrine taxonomy in her later paper, she noted that "In every subgenus of *Scaphinotus* are species that share characters of another, probably closely related, subgenus. Of course, all species belonging to any group have the quite distinct characters of their own subgenus." The *Stenocantharus*/*Brennus* division was convenient and realistic enough for Van Dyke (1944), Hatch (1953), and Ball (1960) to endorse, in addition to Gidaspow. Lindroth (1961) gave different names (*angusticollis* group and *marginatus* group) to the same taxa. It is not good taxonomy to reclassify taxa on the basis of examination of 1 species (4 specimens).

NATURAL HISTORY

S. johnsoni has so far been collected only on the northern Olympic Peninsula and the southern part of Vancouver Island, but appears to be fairly widespread in these restricted areas. It has been found at 4500 feet at Boulder Lake, 3.5 miles W from Olympic Hot Springs (Hatch 1948), and close to sea level near Sooke, on Vancouver Island (Lindroth 1961) and at Toleak Point. At 800 feet, Klahowya is not technically "rain forest" as Perrault described it. This designation is reserved for old-growth, near-climax forests in the coastal *Picea sitchensis* zone, dominated by *P. sitchensis* and *Tsuga heterophylla* and meeting several other criteria (Franklin and Dyrness 1973). Klahowya is on the border of the *P. sitchensis* and *T. heterophylla* zones and has an overstory dominated by comparatively young *T. heterophylla*, which is the only conifer successfully reproducing.

However, the term is probably not critical so far as the requirements of *S. johnsoni* are concerned. As in true rain forest, the forest floor at Klahowya is quite moist, with *Oxalis oregana* and *Polystichum munitum* extremely abundant.

I spent less than 4 hours collecting—mostly breaking apart rotted logs —at Klahowya on 10 and 12 April, 1975. Two of the *S. johnsoni* captured were torpid and deep within the logs, and 3 were within 1 inch of the log surface and became active when exposed. In addition, numerous fragments of this species were found, chiefly elytra and pronota. The only other cychrines collected were 1 *Cychrus tuberculatus* Harris and 3 *S. marginatus* (Fischer). It appears that like another uncommon northwestern cychrine, *S. manni* Wickham, *S. johnsoni* may be relatively abundant in limited areas of favorable habitat.

CONCLUSIONS

The elements contributing to the problem concerning *S. johnsoni/S. klahowyae* are often encountered and hardly unique to this particular case: insufficient material; variation, sometimes considerable, exhibited by individuals of 1 species; and varying interpretations (also sometimes considerable) of the same structure by different illustrators. Lindroth's (1969: xxix) statement that "No scientific description or picture, however detailed and however skillful, is a perfect substitute for the animal itself" cannot be overemphasized. However, accumulating sufficient examples of the animal for evaluation is sometimes difficult. In her revision of *Brennus*, Gidaspow (1968) was able to inspect only 14 specimens of *S. johnsoni*. Therefore, despite his erroneous conclusions, Perrault (1973) performed a valuable service in calling attention to Klahowya as a location where this elusive species may be encountered and studied.

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GYMNETIS CHALCIPES UNDATA (OLIV.) IN PUERTO RICO (COLEOPTERA: SCARABAEIDAE)

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14 Baldorioty Street, Mariani, Ponce, Puerto Rico 00731

On 6 September 1975 I collected 1 specimen of *Gymnetis* (=*Paragymnetis) chalcipes undata* (Olivier) about 3 miles north of Ponce, Puerto Rico, on Road 132. To my knowledge this is the first record of this species, as well as the first record of the subfamily Cetoniinae, from Puerto Rico. The species is recorded from South America and Hispaniola by Blackwelder (1944) and Schenkling (1922).

The specimen was found floating in a large metal drum full of water. There were bananas immersed in the water, a local practice to prevent the green fruit from ripening too soon. I was told the bananas had been bought at the local market-place and placed in the drum the day before. Since bananas are imported from time to time I suspect that the specimen may have been accidentally introduced with bananas. No specimens were found earlier and no additional specimens were found afterwards; I have collected regularly for 5 years at this locality.

Dr. Brett C. Ratcliffe, University of Nebraska, Lincoln, determined the specimen and read the manuscript.

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SOUND PRODUCTION BY SUBSTRATAL TAPPING IN BEETLES OF THE GENUS *EUSATTUS* (TENTYRIIDAE: CONIONTINI)

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Abstract

All 3 investigated species of *Eusattus* produce sounds by tapping the substrate with the venter of the abdomen. Tapping by *E. reticulatus* Say and *E. muricatus* LeC. was mostly restricted to the daytime, but *E. robustus* LeC. tapped mostly by night. At 25°C the tap rate of the first 2 species was about 23 to 25 taps/sec, whereas that for the last was about 12 taps/sec. The duration of tapping bursts was radically different for the 3 species, and loudness and details of pattern varied also. The tap-rate of *E. reticulatus* increased linearly with temperature between 25 and 30°C. Behavioral observations showed that only males tapped, and that the level of tapping was increased significantly by the introduction of a female, but not a male, into a male's container. It is hypothesized that the tapping behavior plays some communicatory role in reproductive behavior.

Introduction

One of the many ways in which insects produce sound for the purpose of communicating is by tapping upon the substrate with part of the body. Such impact-generated sounds have been reported for the ants, *Campanotus ligniperda* and *C. herculeanus* (Markl and Fuchs 1972), termites (Howse 1964), and stoneflies (Rupprecht 1968, 1969), and have been shown in each case to function in communication. Certain woodboring Coleoptera also produce impact sounds (Cymorek 1969), but this mode of sound production seems to be relatively rare among the Coleoptera in general. We report here the discovery that several species of the tentyriid genus *Eusattus* produce stereotyped, species-specific sounds by tapping upon the substrate with the abdominal venter.

Materials and Methods

Specimens were collected live at the following localities: *E. reticulatus* from Balmorhea State Park, Toyavale, Reeves County, Texas; *E. muricatus* from Sand Mountain, 18 mi. W. Frenchman, Churchill County, Nevada; and *E. robustus* from West Cove, San Clemente Island, Los Angeles County, California. The beetles were maintained in boxes on sandy substrate with litter and fed bran and rolled oats. Recordings were made using a Uher 4400 Report Portable Tape Recorder, and the recordings were analysed on a Kay Sound Spectrograph. Ambient temperature was noted during recording, but was not varied experimentally. A Rustrak 8-channel Event Recorder was used to record occurrence of tapping by individuals in groups.

RESULTS

All 3 species of *Eusattus* produce sound by tapping the abdominal venter against the substrate, and in all 3 species it is apparently the male which has this behavior. Typically, the beetle raises the entire posterior of the body and brings it forcibly downward so that the point of impact is about the middle of the abdominal venter. The intensity of the sound thus produced depends to a large degree on the substrate, being louder on resonant substrates; but is also obviously a function of the beetle's size, the largest species (*E. robustus*) producing the loudest sounds.

Sound characteristics. Table 1 shows the characteristics of the sounds produced by 3 species of *Eusattus* at about 25°C. In all cases, the sounds consist of a series or burst of rapidly executed taps with a more or less constant rhythm within the burst. Depending upon the species, each burst of taps consists of 20 to 70 taps produced with a characteristic tap-rate. The sounds of the species differ from one another in tap-rate, burst length, number of taps per burst, and loudness. In addition, the sonograms indicated that the bursts of *E. reticulatus* and *E. muricatus* tended to begin softly for the first few taps, hold steady for most taps, and fade out gradually for the last few taps. *E. robustus* began and ended abruptly. Other than the gradual beginning and ending in the first 2 species, there appears to be no modulation of the tap intensity or frequency (rate) within a burst. *E. muricatus* misses occasional taps within a burst, but this seems to be accidental and is without a consistent pattern.

TABLE 1. Signal properties of the tapping signals of several *Eusattus* species. All measurements at 24 to 26°C.

	Mean (±S.D.)		
Species	*Taps/burst*	*Burst length (sec.)*	*Tap rate (Taps/sec)*
E. reticulatus	36 (±1.2)	1.20 (±0.06)	30 (±0.6)
E. muricatus	47 (±3.7)	2.02 (±0.18)	23.4 (±1.0)
E. robustus	70 (±13.1)	5.84 (±1.1)	12 (±0.5)

Dependence of tap-rate upon temperature. Except for an evaporative cooler, no temperature control devices were available. We therefore merely recorded the ambient room temperature, which ranged between 24 and 32°C, during the recordings. Within this range, the tap-rate within a burst of *E. reticulatus* increased roughly linearly from about 25 taps/sec to about 38 taps/sec (fig. 1). The number of taps per burst showed no relationship to the temperature. The tap rate of the other 2 species also obviously increased with temperature, but this dependence was not specifically determined.

Possible function of the signals. The most reasonable hypothesis concerning function of this tapping behavior is that it has some kind of signal value, most likely in reproduction. A certain amount of circumstantial evidence supports this notion, for only males have ever been observed tapping. We carried out a few simple experiments on *E. reticulatus* to determine whether or not this behavior might play a role in reproduction.

In the first set of experiments (fig. 2) we tested whether the presence of females or other males had any stimulatory or inhibitory effect upon the tapping behavior. Males were isolated in small plastic boxes with a little

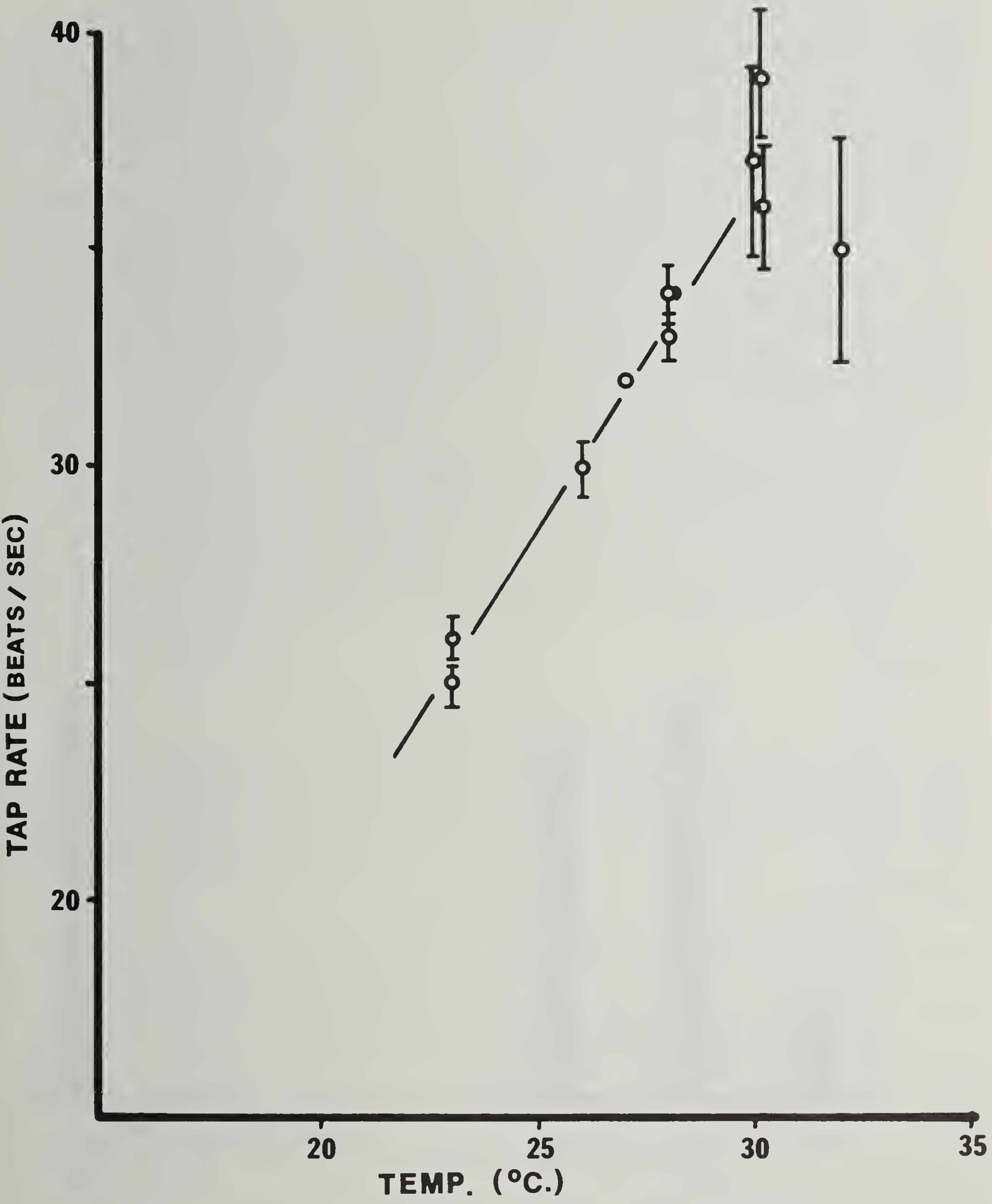

Fig. 1. The tap-rate of *E. reticulatus* as a function of temperature. Each point represents the mean of one individual. The bars are standard deviations.

food. After an acclimation period of several hours, the frequency of bursts of tapping was recorded on an event recorder for ½ hour. Thereupon, a female *E. reticulatus* was placed in the box with the male and the male's tapping was again recorded for ½ hour. The female was then removed and replaced with another male (one of the other males in the same experiment) and the tapping of the resident male recorded. The alien male was then removed and the original male given about 4 hours before its tapping was again recorded while the male was alone. The same procedure was then followed except that the male was introduced first and the female second. The results for 3 such experiments (fig. 1) show that the tapping activity (bursts/½ hour) of males is increased significantly ($p<0.1$) by the introduction of a female, but not by the introduction of a male. In cases where the initial female was replaced with a male, the tapping did not decrease significantly, but this is probably due to a long fade-out period of stimulation by the female rather than to any stimulatory effect by the male. This is supported by experiments in which the male is introduced first.

In isolation over long periods of time, there always occurs some endogenous tapping in the absence of apparent stimulation, and this tapping occurred in bouts rather than being evenly distributed in time. There was a great variation in tendency to tap among the 20 or so *E. reticulatus* males we investigated, ranging from practically zero to very frequently. Some individuals exhibited tapping bouts that lasted several hours, with several bursts per minute.

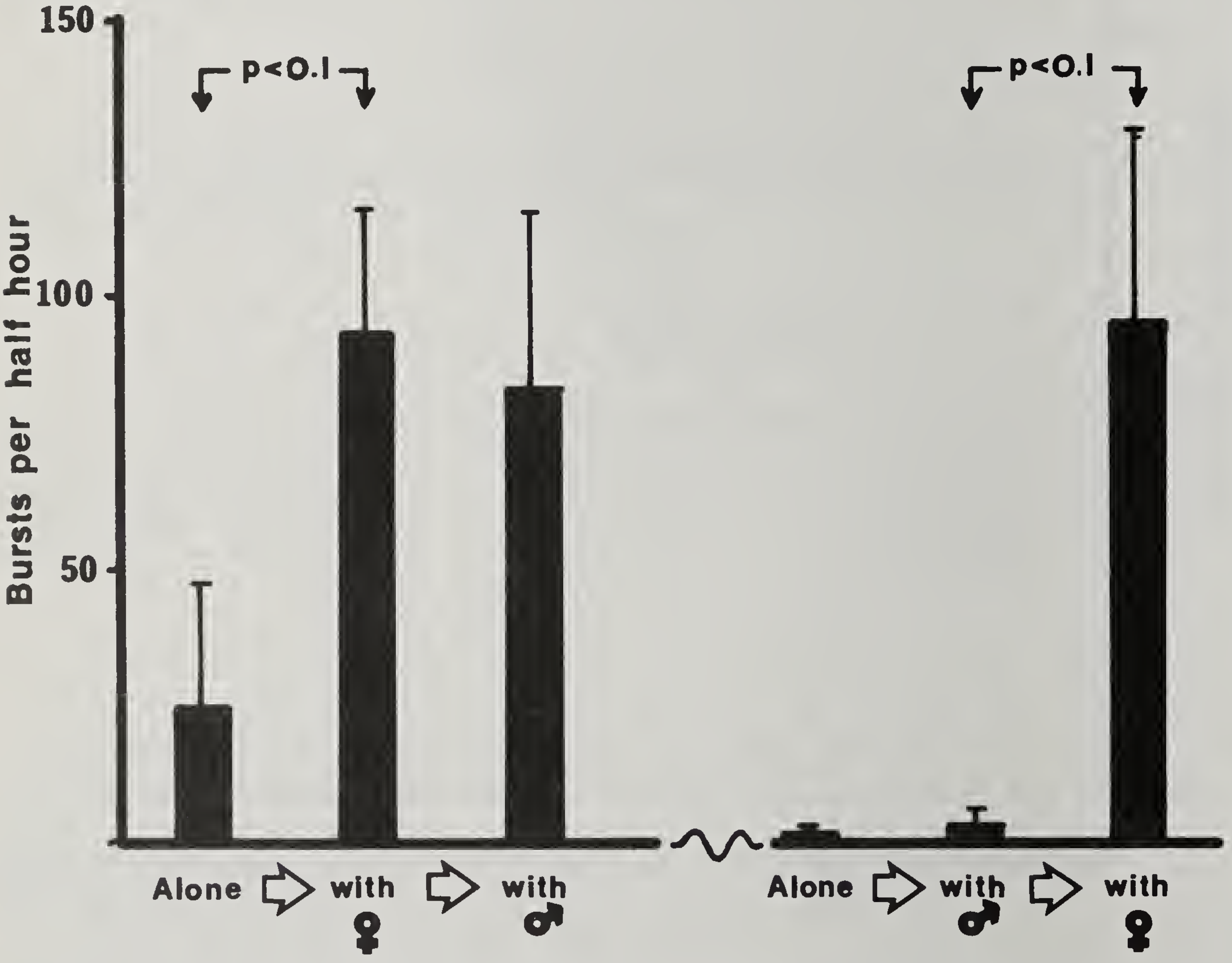

Fig. 2. The effect on burst-frequency of adding either a female or a male to a solitary male *E. reticulatus*. Means of 3 individual test males ± standard error. Treatment carried out in indicated order, from left to right.

We also tested the possibility that females oriented to and were attracted to tapping males as they are in the South African tentyriid, *Molurodes hirtipes* (V. C. Moran, per. comm.). However, females of *E. reticulatus* showed no significant orientation or attraction to tapping males. It is possible, of course, that conditions were not appropriate for attraction or that females were not receptive, and an attracting function is not ruled out.

Discussion

The possibility of a sexual communicative function of the tapping signal of the flightless, ground dwelling *Eusattus* is indicated by such a function having been demonstrated for a related tentyriid species, *Molurodes hirtipes* (V. C. Moran, pers. comm.). In this South African species, both sexes tap with a sex and species-specific pattern, isolating them reproductively from the sympatric *M. pinguis*. Reproductive isolation could not be a function of the tapping behavior of the *Eusattus* species reported on here, for they are mostly allopatric and are certainly ecologically separated.

In *Molurodes hirtipes*, only the male orients to and is attracted by the female's signal. The female remains stationary upon perceiving the male's signal and responds to his signal with her own. Males also answer other males but are not attracted to them. The sound is substrate borne. Such tapping behavior is very widespread among members of the African tribe Molurini and has been observed in a number of species (unpublished observations). Recently, we have discovered that *Eusattus erosus* and *E. difficilis* as well as several American species of the genus *Coniontis* (tribe Contiontini) produce tapping signals. It seems possible that this behavior is widespread among American tentyriids of certain tribes. Even if the purpose of the behavior is not known, it may provide useful information relating to systematic problems.

Acknowledgements

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ADULT FEEDING BY *DYNASTES TITYUS* (LINN.) (COLEOPTERA: SCARABAEIDAE)

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The recent paper by Dr. Glaser on the biology of *Dynastes tityus* (Linn.) in this journal (June 1976) recalled a field observation on adult feeding that I made nearly 50 years ago.

While walking along the edge of a cotton field early on the morning of 24 August 1928 at Meredith, South Carolina, I found a fine male specimen on the ground between two rows of cotton. A step or two further and I was elated to find another. Curious as to where they came from I glanced upward into a small Ash tree and discovered more beetles all over the tree, clinging to limbs up to an inch and a half in diameter. The tree was about 15 to 20 feet tall. Each beetle, its legs wrapped around the limb, appeared to be pushing a small ball of excelsior, feeding on the sap or inner bark. I collected 44 males and 10 females. When handled, the males gave off a strong, characteristic, penetrating odor.

Prof. Franklin Sherman of Clemson College later told me that in North Carolina he had been called to a home to investigate a pungent, disagreeable odor, and he had traced the odor to *Dynastes* feeding on large Ash trees surrounding the house. Apparently Ash (*Fraxinus*, species undetermined) is an attractive source of food for the adult beetles.

A NEW GENUS AND FOUR NEW SPECIES OF NORTH AMERICAN ANOBIIDAE WITH NOTES

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Abstract

Ptilinobium aberrans, new genus, new species, subfamily Anobiinae, is described from Lower California. The new species *Stagetus grossus* (from Arizona) and *Gastrallus fasciatus* (from New Mexico) are described; each is the second North American species in its genus. The fourth new species described is *Xestobium parvum* from California. *Vrilletta montana* VanDyke is synonymized with *Euvrilletta xyletinoides* Fall, and 2 species previously known from Mexico, *Trichodesma sellata* Horn and *Priobium mexicanum* White, are recorded from California and Arizona respectively.

This paper continues my studies on the Anobiidae. My intentions are to make known heretofore undescribed taxa, publish a new synonymy, and add new distribution records, thereby to increase our taxonomic knowledge of this family. The descriptions offered are of assorted species from southwestern United States and Mexican material that I have recently identified; most species, the new synonymy, and the new records will be included in my forthcoming Catalog of Anobiidae of America north of Mexico.

Ptilinobium White, **new genus**

General. Body elongate, subcylindrical; pubescence on most surfaces short, moderate in density; surfaces granulate or punctate.

Head. Front flat nearly throughout; carina over antennal base strong; eyes small, bulging. Antenna short, 10 segmented, segments 3-7 subcylindrical, segments 8-10 elongated. Maxillary and labial palpi each with last segment elongated, subfusiform.

Dorsal surface. Pronotum asperate anteriorly and on disk; anterior margin produced and recurved; under surface of pronotum bearing long hairs; lateral margin distinct, nearly complete. Scutellum moderate in size. Elytra punctate, striate, striae more or less distinct; humeri distinct, granulate.

Ventral surface. Prosternum narrow before coxae, front and middle coxae large, subconical, members of each pair touching; metasternum granulate; hind coxae touching, lower margin of each carinate, each coxa nearly attaining lower margin of elytron. Abdomen with first suture straight, weak, remaining sutures straight, distinct; abdominal segment 2 longest, remaining segments subequal in length. Anterior tibia with outer margin denticulate, apex with a curved spine; middle tibia with outer margin weakly denticulate, apex with a spine; tarsi long, first and last tarsal segments longest, 4th segment very small. Male genitalia with lateral lobes broad, apices pointed inwardly; median lobe narrowed medially.

The combination of antennal form and cylindrical body indicates that this genus belongs in the subfamily Anobiinae. The species upon which the genus is founded is one of the most aberrant anobiids I have seen, and I find it difficult to name a genus of Anobiinae to which this genus is allied. The asperate pronotum and denticulate front tibiae strengthen my view that the subfamily Ptilininae should be reduced to a tribe of Anobiinae, since these characters were once regarded as unique for Ptilininae.

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Ptilinobium is separable from members of Ptilininae in that the antenna (typical for Anobiinae) has the basal segments reduced and cylindrical, and the 3 apical segments much enlarged. Members of Ptilininae have the antenna serrate in the female, pectinate in the male. The following combination of characters is distinctive for *Ptilinobium*: pronotum asperate, front margin produced, recurved, pubescent beneath; antenna 10 segmented, basal segments reduced, apical 3 segments enlarged; head flat; anterior and middle tibia with outer margin of each denticulate.

Ptilinobium is a neo-Latin name formed by combining ptilin- from *Ptilinus* with -obium from *Anobium*; the gender is neuter.

Type-species. *Ptilinobium aberrans* White, new species.

Ptilinobium aberrans White, **new species**
(Fig. 1, 3)

General. Body about 2.9 times as long as wide; sides of elytra subparallel in basal 2/3; pronotum a little narrower than elytra basally. Pubescence yellowish, very short, subappressed; dorsal surface and head with intermixed, erect hairs. Body surfaces more or less shiny. Head and pronotum mostly black, pronotum anteriorly red brown; elytra, antennae, and most of legs red brown; ventral surface mostly dark brown.

Head. Front flat nearly throughout, broadly depressed behind clypeus; vertex with a short, distinct, longitudinal carina; carina over antennal base distinctly produced; surface with moderately dense granulation; eyes small, separated by 2.5 times vertical diameter of eye. Antennal segment 1 broad, arcuate; segment 2 smaller, longer than wide; segment 3 subcylindrical, about 2 times as long as wide; 4th segment a little shorter, wider than 3rd; 5th and 7th segments subequal, small, each a little longer than wide; 6th segment similar to 4th but shorter; segments 8-10 enlarged and elongated, together about 1.5 times as long as all preceding united, segments 8 and 9 similar, each widest before base, each about 3 times as long as wide; segment 10 widest before apex, about 4 times as long as wide. Maxillary and labial palpi with long pubescence; last segment of maxillary palpus widest before middle, weakly arcuate, pointed apically, about 3 times as long as wide; last segment of labial palpus widest about middle, distinctly arcuate, pointed apically, a little over 2 times as long as wide.

Dorsal surface. Pronotum with asperities largest medially in anterior half, a little smaller each side of middle, smallest medially before base; anterior portion broadly, distinctly recurved; undersurface granulate, set off posteriorly by a carina, bearing long, arcuate hairs; pronotal surface punctate throughout, punctures smallest and densest basally. Elytron with punctures forming more or less distinct, somewhat impressed striae, striae weakest apically and at side; surface coarsely granulate.

Ventral surface. Metasternum with fine granules on minutely granulate surface; abdomen finely granulate.

Length. 4.8 mm.

Holotype. Male, LOWER CALIFORNIA, 10 miles east of Mesquital, June 23, 1938, Michelbacher and Ross. Deposited in CAS.

Host. Unknown.

Discussion. This specimen is damaged, with most of the right elytron, an entire hind leg, and the tarsus of the other hind leg missing.

Xestobium parvum White, **new species**
(Fig. 2)

General. Body elongate, cylindrical 2.2-2.5 times as long as wide; body and appendages orange brown to dark brown, head and pronotum usually darkest; pubescence dull yellowish, uniform in color and density, moderate in length, hairs arcuate, weakly bristling in part; most surfaces punctate, some punctate granulate.

Head. Front moderately densely punctate; rims of punctures raised, appearance granulate; clypeus distinctly depressed. Eyes of male bulging, separated by about 2 times vertical diameter of eye; eyes of female less bulging, smaller, separated by over 2 to nearly 3 times vertical diameter of eye. Antenna of male about 0.6 times as long as body, that of female about 0.4 times as long as body; 3 and 5 longest of intermediate segments, 4 next, 6 and 8 shortest; in male last 3 segments about 2 times as long as all preceding united, last 3 segments each 3.5 to 6.0 times as long as wide, last most elongated; in female last 3 segments a little longer than all preceding united, last 3 segments each 2.5-3.0 times as long as wide. Last segment of maxillary palpus subfusiform, about 2 times as long as wide; last segment of labial palpus subtriangular, about 1.5 times as long as wide.

Dorsal surface. Pronotum with a weak longitudinal ridge medially before base, in front of this a weak depression or shallow groove; surface with additional irregularities, especially before base; lateral margin sharp, distinct, complete, explanate, finely serrulate; pronotum at side concave; surface punctate throughout, rims of punctures raised, with granulate appearance. Scutellum wider than long, apex rounded. Elytra nonstriate, with small punctures, moderate in density.

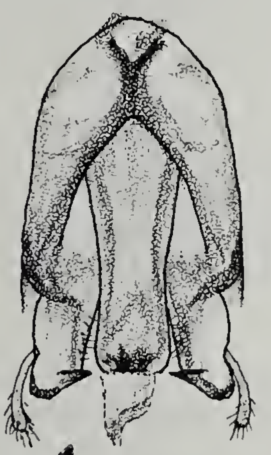
Ventral surface. Moderately densely punctate. Abdominal apex unmodified in both sexes.

Length. 2.7-4.3 mm.

Holotype. Male, CALIFORNIA, hills back of Oakland, April 3, 1931, E. C. Zimmerman. USNM type no. 73742.

Allotype. CALIFORNIA, San Mateo Co., A. Koebele. In USNM.

Paratypes. CALIFORNIA, Alameda Co., San Leandro, T. W. Davies property, 791 Elsie Ave., reared, emerged June 22, 1971, H. B. Leech (2 males, in CAS); 4 males with same data as before except 1 with June 9, 1971, 1 with June 25, 1971, 1 with June 1, 1971, and 1 with June 23, 1971 (first 2 in CAS, last 2 in USNM); Marin Co., Novato, May 19, 1952, J. W. Green (1 male in CAS); Marin Co., Mill Valley, June 30, 1925, E. P. VanDuzee (1 male in CAS); Inverness, June 8, 1950, D. Giuliana (1 male in CAS); Stanford Univ., "4-9 1959", P. S. Bartholomew (1 male in USNM); San Francisco, June 28, 1960, H. B. Leech (2 females in CAS); Alameda, "1/691", Koebele (1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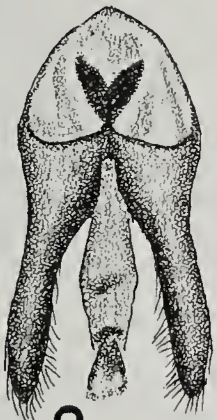
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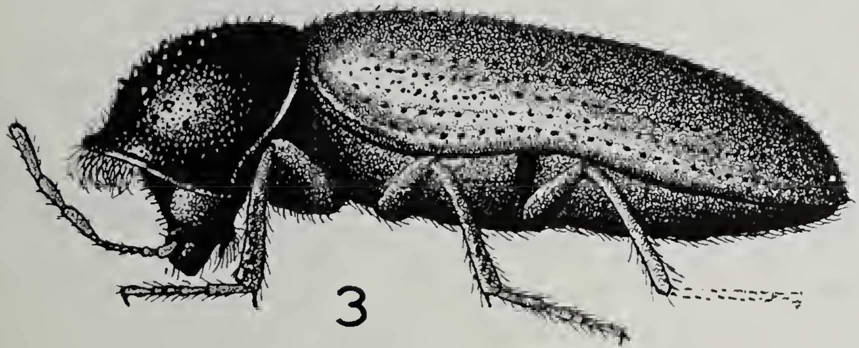
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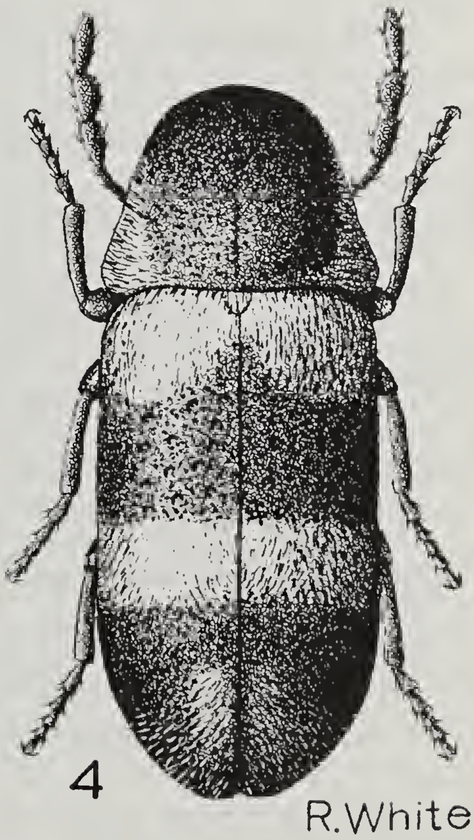
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Fig. 1-2, Male genitalia: Fig. 1, *Ptilinobium aberrans* White, holotype; Fig. 2, *Xestobium parvum* White; Fig. 3, *P. aberrans* White, holotype; Fig. 4, *Gastrallus fasciatus* White, male holotype.

female in CAS); San Francisco, A Koebele (1 male in USNM); "Vance", June 1, 1903, H. S. Barber (1 male in USNM); California, Ricksecker, Hubbard and Schwarz (1 female in USNM). There are thus 15 paratypes.

Host. Reared from branch of *Prunus avium* L.

Discussion. This species runs to *X. marginicolle* (Lec.) in my key to species of *Xestobium* (White 1975a, p. 84). *X. marginicolle* has the pubescence distinctly bristling in part (versus weakly bristling), its length is 3.7-5.7 mm (versus 2.7-4.3 mm), in the female the apex of the abdomen is bituberculate (versus not tuberculate) and the median lobe of the male genitalia is subparallel and each lateral lobe is indented apically (versus median lobe widest near middle and lateral lobes not indented).

Fall (1905 p. 150-51) obviously saw members of this species but failed to recognize them as distinct from *X. marginicolle.* He referred to a varietal form that almost totally lacked erect hairs and, in the female, lacked tubercules on the abdomen.

LeConte in his original description of *X. marginicolle* (1859, p. 87) gave the length of "long .21" (=5.3 mm), so there can be no doubt that the description does not refer to the new species.

Stagetus grossus White, **new species**

General. Body suboval, a little over 1.7 times as long as wide; pubescence yellowish, moderate in length and density, on all surfaces partly inclined, partly bristling; body throughout and legs nearly uniformly dark brown, antenna brown.

Head. Front nearly evenly convex, with a distinct, deep groove adjacent to each eye; surface with large, coarse, dense punctures, variable in size, nearly running together; eyes large, moderately convex, separated by 1.4 times vertical diameter of eye. Antenna with segments 2-8 reduced; segments 5 and 7 distinctly produced inwardly; segments 4, 6, and 8 weakly produced inwardly; segments 9, 10, and 11 enlarged, longer than all preceding united, segments 9 and 10 subtriangular, each longer than wide, 11th segment about 3 times as long as wide. Palpi very large, broad, subtriangular, widest basally, inner margins explanate; last segment of maxillary palpus about 1.5 times as long as wide; last segment of labial palpus a little longer than wide.

Dorsal surface. Pronotum subconical in form; lateral margin sharp, distinct, nearly complete; surface with dual system of punctures, large punctures on disk separated by about diameter of a puncture, large punctures much smaller on base and apex and somewhat smaller on sides than on disk of pronotum; small punctures nearly even throughout. Scutellum subtriangular, wider than long. Elytron with a scutellar and 10 complete, strongly, evenly impressed striae; surface finely, moderately densely punctate throughout.

Ventral surface. Metasternum with a short, longitudinal carina behind intercoxal process, a short, triangular impression behind carina each side of middle; large, dense punctures at base variable in size, separated on average by less than diameter of a puncture, punctures at side extending past middle; small punctures evenly distributed. Abdomen at sides carinate, carina extending to abdominal apex; surface with large and dense punctures, these densest and nearly running together near apex.

Length. 3.9 mm.

Holotype. Male, ARIZONA, Huachuca Mts., Upper Carr Canyon, 7500 feet, August 6-10, 1952, H. B. Leech and J. W. Green. Deposited in CAS.

Host. Unknown.

Discussion. I tried to remove the abdomen of the type to sex it, but had to cease the attempt when it became clear that damage might result.

This species is distinguished from *S. profundus* (Lec.), the only other described species of the genus north of Mexico, by the length, 3.9 mm (versus 2.0-2.5 for *S. profundus*), the non-sulcate metasternum (deeply grooved at middle in *S. profundus*), and the very large, dense punctures on the head (small, not dense in *S. profundus*). Also, *S. profundus* is known from northeast to western U.S., and *S. grossus* is known from only Arizona.

The specific epithet *grossus* refers to the large size.

Gastrallus fasciatus White, **new species**

(Fig. 4)

General. Body elongate cylindrical, nearly 2.3 times as long as wide, sides of elytra subparallel in about basal 3/4; body and appendages brown to red-brown; pubescence short, appressed, moderate in density, obscuring surface sculpture, brown in part, whitish in part, forming an elytral pattern.

Head. Nearly flat front to back; surface finely granulate; eyes moderate in size, moderately bulging, separated by about 2-3 times vertical diameter of eye. Antenna 9 segmented, 0.3-0.4 times as long as body; segment 1 large; segment 2 moderate in size; segments 3-6 small; segments 7-9 enlarged, longer than all preceding united, segments 7 and 8 subequal, each a little longer than wide, segment 9 about 2 times as long as wide. Maxillary and labial palpi each with last segment subfusiform, and about 2 times as long as wide.

Dorsal surface. Pronotum as wide as to a little wider than elytra at base; disk convex, side nearly concave front to back, with obscure, median, longitudinal impression; surface granulate punctate, punctures largest, most distinct at sides; lateral margin sharp, explanate, not attaining anterior margin; whitish pubescence at sides only, remainder with brown pubescence. Scutellum short, broad, wider than long, apex truncate. Elytra lacking striae; surface granulate punctate; whitish pubescence forming basal, submedian and apical bands, submedian band broadened at sides.

Ventral surface. Anterior coxae (and also middle coxae) widely separated; metasternum finely granulate punctate; abdomen finely, obscurely granulate punctate, first abdominal suture nearly obliterated at middle, remaining sutures distinct.

Length. 1.40-1.75 mm.

Holotype. Male, NEW MEXICO, Otero Co., High Rolls, July 13, 1974, D. E. Bright. Deposited in CNC.

Paratypes. Three (probably males) with same data as above. One is in CNC, 2 are in USNM.

Host. *Koeberlinia spinosa* Zucc.

Discussion. This species is readily distinguished from our only other member of the genus, *G. marginipennis* Lec., in having elytral fasciae of pubescence; *G. marginipennis* has pubescence uniform.

Euvrilletta xyletinoides Fall

Euvrilletta xyletinoides Fall 1905, p. 197.
Vrilletta montana VanDyke 1946, p. 85. **New synonymy.**

I examined the holotype of *V. montana* and found it to be identical with *E. xyletinoides.*

New U. S. Records of Anobiidae

The 2 new records below are from specimens I identified from the California Academy of Sciences Collection.

Trichodesma sellata Horn. Formerly known only from Lower California; I examined an individual from San Diego Co., California, taken on Sept. 14, 1949 by E. R. Leach.

Priobium mexicanum White. I (White 1975b, p. 174) described this species from Durango, Mexico. Additional specimens are from 5 mi. west of Portal, Arizona, taken on June 13, 1958 by C. D. MacNeill, and from Chiricahua Mts., Arizona, taken on August 6, 1933 by O. Bryant.

Acknowledgements

My thanks are offered to David Kavanaugh of the California Academy of Sciences (San Francisco, CAS) and to Donald Bright of the Biosystematics Research Institute (Ottawa, Canada, CNC) for loans of specimens important to this work.

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SYSTENA BIMARGINATA SMITH, NEW NAME, TO REPLACE *SYSTENA PLICATA* BLAKE (COLEOPTERA: CHRYSOMELIDAE, ALTICINAE)

ERIC H. SMITH

Field Museum of Natural History, Roosevelt Road at Lake Shore Drive,
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Systena bimarginata Smith, **new name**

Systena plicata Blake 1959:246.

Type-locality: Sierra del Cristal, Oriente Province, Cuba.

Type-location: U. S. National Museum, Type No. 64664.

Remarks: name preoccupied by *Systena plicata* Blatchley 1921:26 (**type-locality:** near Half-Moon Pond, Posey Co., Indiana; **type-location:** Purdue Univ., W. Lafayette, Indiana).

Blake (1959:246) described a new species of *Systena* from Cuba as *S. plicata.* However, this name was preoccupied by *S. plicata* Blatchley (1921:26), a species of flea beetle found in the eastern U. S. Blake's name is therefore a junior homonym and, according to Articles 53 and 60 of the International Code of Zoological Nomenclature, must be replaced.

I first discovered this problem while revising *Systena* (Smith 1970) and talked to Mrs. Blake about it. She suggested that I propose a replacement name. Therefore, I propose the name *S. bimarginata* Smith to replace *S. plicata* Blake.

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COURTSHIP AND MATING IN *HIPPOMELAS PLANICOSTA* (COLEOPTERA: BUPRESTIDAE)

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Abstract

Mating pairs of *Hippomelas planicosta* remain together for several hours during which time they copulate repeatedly, the male resting on the back of the female in the intervals between copulations. Males stroke their partners with their legs and antennae before, during, and between copulations. Bouts of courtship stroking occur more frequently during copulation than in the resting periods. Stroking may serve to elevate the sexual motivation of the female, eliciting copulation and preventing her premature departure. Intermittent copulation may permit the male to leave the female more quickly if threatened by a predator during a resting period, yet still allow the male to guard the female against takeover by other males.

Introduction

There are few records of the reproductive behavior of buprestid beetles. Females of *Xenorhipis brendeli* LeC. release a sex pheromone that attracts males (Wellso 1966); males and females of *Polycesta abdita* Barr signal their location by thumping their abdomens on woody substrate (Beer 1970); and in several species of *Agrilus* the male is above the female and oriented in the same direction during a copulation of short duration (Carlson & Knight 1969; Dutt 1969). Here I describe the courtship and copulatory behavior of a large desert buprestid, *Hippomelas planicosta* (LeConte), which I observed from 15-22 July 1975 in the Semi-Regional Park of Avondale, AZ. Much of the park consists of an open sandy floodplain laid down by the nearby Gila River, with scattered creosote bushes, *Larrea divaricata* Cav., a plant whose leaves and stems are eaten by the adult buprestids.

Results

The beetles are active reproductively throughout the daylight hours, with copulating pairs present from 0700-1700, but the period from 0800-1100 appears to be the peak time for mating. Males of *H. planicosta* fly about creosote bushes and sometimes alight on the back of a conspecific individual or a mating pair. Since the perched individuals are immobile and generally well-concealed, olfactory cues may play a role in the location of conspecifics. Males that land upon a mating pair quickly attempt copulation with the beetle immediately beneath them (the male) and then depart. Males that secure a single individual will also initially attempt copulation (unsuccessfully in my observations) and then may engage in courtship stroking (see below) for a moment or for as much as 10 minutes before leaving without copulating.

Successful courtship and mating in *H. planicosta* consists of 2 alternating components: a passive phase in which the male rests above the female and a copulatory phase (Figs. 1, 2). Males that induce a female to copulate then alternate passive and copulatory phases for a prolonged period (more than 2½ hr in 2 pairs that were watched for this length of time).

In the passive phase the male grasps the female and rests on her back without attempting copulation. The tibiae of the male's forelegs press lightly against the edges of her elytra and adjacent anterior abdomen. The hindlegs are wrapped loosely about her posterior abdomen. The midlegs play no role in gripping the female but instead are held out away from her body.

At intervals during the passive phase, the male will engage in a short bout of courtship stroking. The midlegs draw in to the side of the female and then energetically rub against her elytra and abdominal venter. These legs move very rapidly back and forth along approximately ½ the total length of the elytra for 2-5 seconds, and then return to the resting position. In a stroking bout, the tarsi of the male's hindlegs, moving in conjunction with the midlegs, pat the posterior venter of the female's abdomen. In addition, the forelegs may move jerkily about the side of the female's thorax, although this action is far less pronounced than the movements of the other 2 pairs of legs. Finally, the male's antennae drum against the dorsum of the female's thorax or head, or lash the female's antennae, depending on the relative size of the 2 partners (when the male is much smaller than his mate, his antennae cannot reach the head region of the female.)

In the passive phase, stroking often is triggered by movement of the female which normally is sedentary when paired (although she may feed on the stems and leaves on which she rests). Eighty-three of 200 stroking bouts by 8 males took place during the relatively rare moments when the female was walking forward. Another 38% occurred apparently spontaneously as the pair rested motionless on a creosote limb or twig. The final 20% were associated with penile extrusion by the male just prior to an attempted copulation.

As a stroking bout terminates, the male may return to resting passively or may extrude his aedeagus and attempt copulation. Initially this organ points backwards and must be bent downward and then forward into the female's genital opening. Receptive females permit insertion of the aedeagus; copulation lasts about 90 seconds on average but is highly variable in duration. Following withdrawal of the aedeagus, the pair will wait an average of about 3 minutes before the next copulation. Again the length of the passive phase is highly variable (Table 1).

During copulation males engage in significantly more stroking bouts per minute than during the passive intercopulatory phase (Table 1). The performance of the stroking movements, however, is identical to that described above.

Discussion

Two questions on the reproductive behavior of *H. planicosta* need further examination. First, what is the significance of stroking by males? Second, why is copulation intermittent instead of continuous in this species?

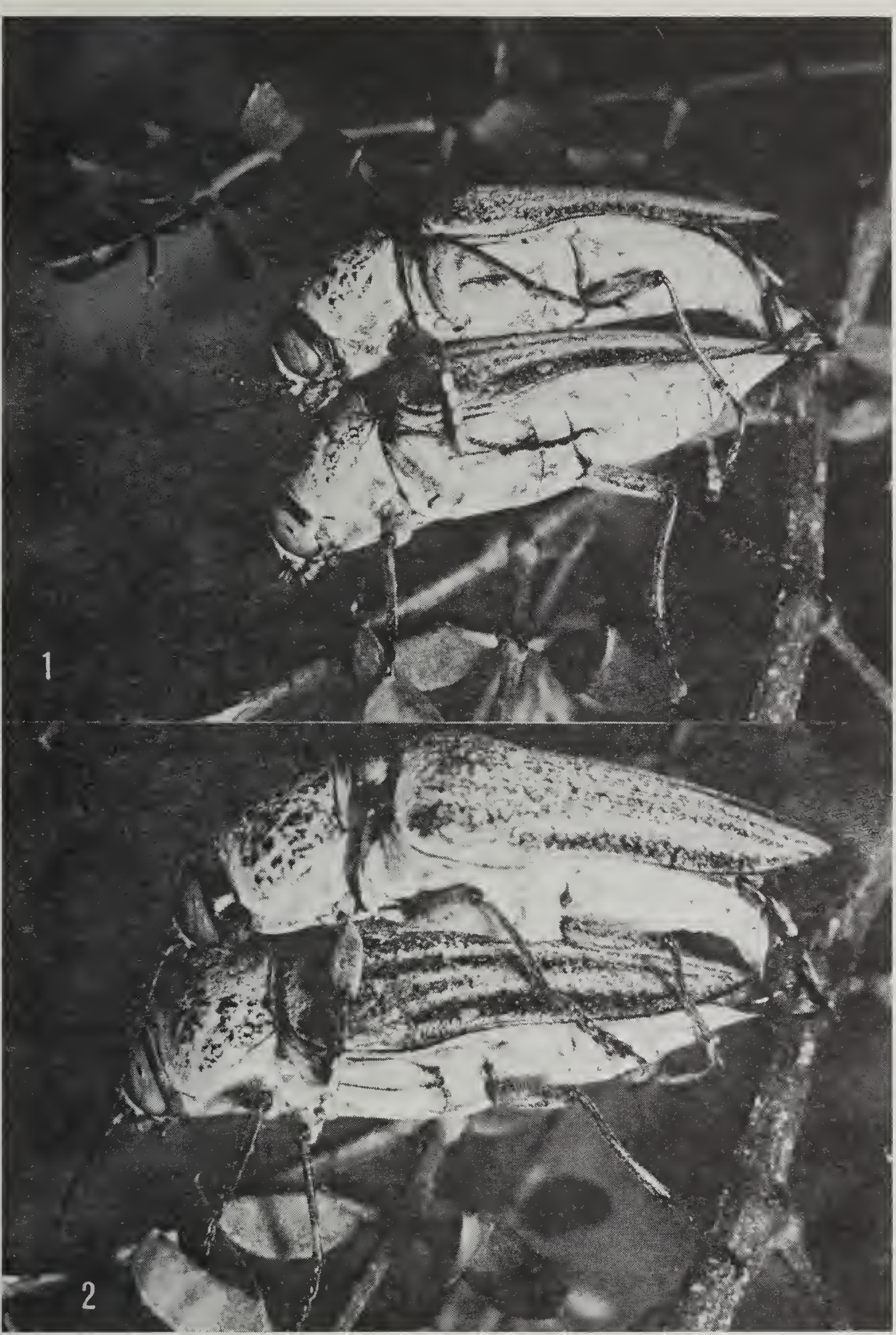

Fig. 1-2. Copulating pairs of *Hippomelas planicosta*. (1) The male (above the female) has inserted his aedeagus but is not stroking his partner. Note that his midlegs are drawn up and away from the female. The male's forelegs happen to grip the female's midlegs in this case, but more normally all the female's legs are free. (2) Stroking by the male. Note the position of the midlegs and antennae of the male. The yellow scales on the lateral edge of the female's elytra have been removed where the male rubbed the female with his midlegs.

Table 1. Duration and frequency of the components of courtship in *H. planicosta*.

	Mean	Range
Duration of observation per mating pair[1]	17.4 min	(8.9-36.4 min)
Percentage of time pair spent *in copulo*	35.5%	(23-49%)
Number of stroking bouts per minute		
- in the copulatory phase	6.5 bouts[2]	(3.0-9.5)
- in the passive phase	2.5 bouts	(0.7-6.6)
Duration of single copulations	89 sec	(29-180 sec)
Duration of interval between successive copulations	172 sec	(14-655 sec)

[1] Data are derived from observations of 10 mating pairs; each pair completed 4 consecutive bouts of copulation and 4 resting periods between copulations.

[2] Stroking occurs significantly more often during copulation.

$t = 4.47$, d.f.$= 1$, $p < 0.01$

The generation of tactile signals by the legs and antennae is common among male beetles, including carabids (Erwin 1967), cerambycids (Michelsen 1966), cucujids (Wojcik 1969), curculionids (Hagley 1965), lyctids (Wright 1960), meloids (Selander & Pinto 1967), rhipiphorids (Linsley *et al.* 1952), tenebrionids (Wojcik 1969), and doubtless other families as well. Most often this involves rubbing the legs against the sides of the elytra and abdomen of the female and antennation of the female's antennae. Some authors have recognized that a passive state on the part of the female is a necessary condition for copulation and that tactile signals by the male appear in several cases to induce immobility and receptivity in the female (Selander 1964; Michelsen 1966; Wojcik 1969).

In *H. planicosta* the tactile signals provided by the male presumably communicate that he is a conspecific to a female. This may promote cooperation from her by elevating her sexual motivation at moments when this is especially critical to the male. Males employ stroking bouts (1) immediately before almost every attempted copulation, (2) more frequently during copulation than during the passive phase, and (3) often when the female is moving during the passive phase. (1) Males must elicit cooperation if the female is to permit entry of the aedeagus. (2) During copulation, stroking may maintain sexual motivation and prevent premature termination of the copulatory bout. (3) A female that is moving is presumably more likely to escape from the male than one that is still. I saw unreceptive females terminate courtship by walking rapidly along a limb until their would-be mate was brushed from their back. They would then fly away. Stroking by the male when the female moves may be part of the male strategy to prevent movement and departure of mating partners. Wojcik (1969) made similar observations on several species of stored-product beetles; however, Selander & Pinto (1967) found that in the meloid *Linsleya convexa* leg rubbing was *less* frequent when the females were active than when they were passive and immobile.

Stroking, then, may increase the duration of the partnership and elicit cooperation in recurring copulations. Throughout this time the male is on the back of the female and can prevent her from mating with another male. Guarding the female may be an important element of male behavior, although it is not known if a recently mated female will accept another suitor or if sperm competition (Parker 1970) occurs in multiple-mated females. In any case, males do remain with females for several hours but do not copulate continuously during this time. Similar patterns have been reported for a lyctid (Wright 1960) and a weevil (Hadley 1965). What advantage might a male gain from repeated intermittent copulations with the the same female over a period of (x), as opposed to *either* (1) an uninterrupted copulation of duration (y) followed by a period of guarding of duration (x-y) *or* (2) a single continuous copulation of duration (x)?

Perhaps alternative (1) has not evolved because through repeated copulations the male may induce the female to remain with him longer than if he were to copulate continuously for some time and then simply rest on her back. In the time following the continuous copulation, the male would have nothing to offer the female and would actually interfere with the performance of other activities (feeding, oviposition) important to the female. It seems likely that with each intromission the female receives additional sperm and accessory fluids that may be of use to her, either increasing her sperm supply or the supply of protein rich materials that she may later metabolize. If so, it may be to her advantage not to break away from the male until many separate copulations have occurred.

Option (2) may be disadvantageous due to predation pressure. The buprestid is sensitive to the presence of observers. Pairs resting between copulations can and do break apart quickly on the approach of a human, with each member flying rapidly away. This suggests that they have been subject to selection for vigilant behavior and the avoidance of potential enemies, which may include large insectivorous birds. Another possible predator is the sphecid wasp *Cerceris grandis* Banks. This large *Cerceris* belongs to a subgroup within the genus whose members are characterized by a set of morphological traits and the use of Buprestidae as prey, although there were no prey records for *C. grandis* when Scullen (1965) included it in the group. I failed to observe the wasp taking the buprestid. However, I regularly saw *C. grandis* females circling around creosote bushes as if hunting; once a wasp pursued a flying *H. planicosta* and once a female actually alighted on a copulating pair, although it left without attempting to capture either individual. If the wasp were a significant predator, it could be that it and other enemies unknown to me are selective agents favoring intermittent bouts of copulation. During passive intervals the pair probably can separate from each other more readily if threatened than when *in copula*.

ACKNOWLEDGEMENTS

G. H. Nelson kindly identified the beetle. John D. Pinto, Jack Schuster, and Daniel P. Wojcik all helped provide information about the pertinent literature. David Skryja volunteered to assist me in the field and I thank him for his very useful help in collecting data. This work was supported by a Faculty Grant-in-Aid from Arizona State University and by National Science Foundation grant GB 42865.

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NOTES ON THE ECOLOGY AND DISTRIBUTION OF WESTERN CERAMBYCIDAE (COLEOPTERA)

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ABSTRACT

Previously unrecorded larval hosts, adult habits, and distributional data are presented for 63 species of Cerambycidae from western North America. An unusual population of *Tragidion coquus* (Linnaeus) is discussed and compared to *Tragidion annulatum* LeConte and *Tragidion auripenne* Casey. The attraction of *Tragidion peninsulare californicum* Linsley to fire is recorded. *Parevander xanthomelas* (Guerin) and *Anoplocurius incompletus* Linsley are recorded for the first time from the United States. Comparative habits or taxonomic differentiation are discussed for an additional 20 species.

Although the cerambycid beetle fauna of the western United States has been actively studied for many years, life histories of many species remain either unknown or unrecorded.

Recent monographic treatment of the family by Linsley (1962a, 1962b, 1963, 1964) and Linsley & Chemsak (1972) has greatly facilitated identification of material, and several annotated lists, dealing primarily with species already treated in the monograph, have subsequently appeared (Tyson 1966, 1970; Penrose & Westcott 1974). The field and rearing information assembled herein is generally supportive of the monograph, primarily representing unrecorded larval hosts and adult habits or significant new distributional data.

Specimens accumulated during these investigations are in the collections of the authors, Los Angeles County Natural History Museum, Placerita Canyon Nature Center, California State University Northridge, and the private collections of individuals cited in the acknowledgements.

PARANDRINAE

Parandra marginicollis marginicollis Schaeffer. Linsley (1962a) records this species as occurring beneath bark of *Platanus* and *Alnus* in southern California. In the San Fernando Valley, Los Angeles County, we found it working the heartwood of declining cultivated walnut trees (*Juglans* sp.). The beetles live in large colonies within the hollowed trunks, larvae feeding adjacent to the still-living outer tissue, thereby hastening death of the tree. Heavily infested trees are frequently severely damaged by storms.

PRIONINAE

Stenodontes arizonicus (Casey). Adults are commonly attracted to light in July and August in the mountains of southern Arizona, and have been taken by D. G. Marqua on the trunks of living oak trees (*Quercus* spp.). We found the larvae mining the heartwood of healthy young trees, and adult emergence holes are conspicuous in the lower trunks of older trees.

Ergates pauper Linsley. Tyson (1966, 1967) records *E. pauper* from Canyon Oak (*Quercus chrysolepis* Liebm.) and Interior Oak (*Q. wislizenii* A.DC.). To these we add Coast Live Oak (*Q. agrifolia* Nee) and Black Oak (*Q. kelloggi* Newb.). The latter record is somewhat tentative, based upon a single adult emergence hole in the trunk of a dead, standing tree in the San Bernardino Mountains. *E. pauper* is sporadically abundant in the mountains of southern California, ranging from near sea level to above 6000 feet. In the San Gabriel Mountains we found it occurring sympatrically with *Ergates spiculatus spiculatus* (LeConte), which commonly feeds in dead *Pinus ponderosa* Dougl.

Prionus lecontei Lameere. This species infests the living roots of oak trees, and is found throughout lower elevations in the Sierra Nevada range and mountains of southern California. We found it to be abundant in the desert foothills, where the larvae are associated with Coast Live Oak and Scrub Oak (*Quercus dumosa* Nutt.). Adults emerge from the bases of infested trees in late summer, and males are commonly attracted to light. In areas of sympatry with *Prionus californicus* Mots., its period of adult activity is generally later than that of *P. californicus*, often extending into early September.

Prionus heroicus Semenov. We collected adult females in July from beneath leaf debris at the bases of oak stumps in the Huachuca Mountains of southern Arizona, and it is probable that oak roots serve as the larval food.

Tragosoma depsarius (Linnaeus). We cut adults and pupae of this widespread species from decaying trunks of Pinyon Pine (*Pinus monophylla* Torr. & Frem.) near Mahogany Flats in the Panamint Mountains of eastern California. This species was not recorded by Tyson (1970).

LEPTURINAE

Xylosteus ornatus LeConte. A single female of this rarely collected species was beaten by E. F. Giesbert from dead portions of a living Elderberry bush (*Sambucus* sp.) in company with *Desmocerus auripennis auripennis* Chevrolat in July, near Buck's Summit, Plumas County, California.

Pyrotrichus vitticollis LeConte. This species has been recorded as breeding in *Acer*, *Alnus*, *Populus*, and *Umbellularia* (Linsley & Chemsak 1972). In southern California we encountered it in abundance in rotting limbs and trunk scars of large willow trees (*Salix* sp.).

Cortodera stolida (Casey). Linsley & Chemsak (1972) record this species as having been beaten from *Juniperus*. Specimens were beaten by G. Walters from Pinyon Pine in the Panamint Mountains, and by the authors from the blossoms of Canyon Oak in June on the north slope of the San Gabriel Mountains.

Orthochoriolaus chihuahuae (Bates). Adults were collected by A. E. Lewis and the authors in July in the Huachuca Mountains on the blossoms of Milkweed (*Asclepias* sp., probably *speciosa* Torr.) Squawbush (*Rhus trilobata* Nutt.), and *Nolina microcarpa* Wats. A few specimens were also taken by beating the outer foliage of oak trees.

Dorcasina grossa (LeConte). This all-black species was reared by C. E. Langston and the authors from the root crown and lower trunk of rotting Incense Cedar (*Calocedrus decurrens* Torr.) from the Greenhorn Mountains, Kern County, California. Several adults were collected by F. T. Hovore from piles of Douglas Fir (*Pseudotsuga menziesii* Mirb.) sawdust at a mill near Inwood, Shasta County.

CERAMBYCINAE

Opsimus quadrilineatus Mannerheim. This species has previously been recorded as breeding in a variety of coniferous hosts from Santa Cruz County, California, north to Alaska (Linsley 1962b). We collected a series of adults in February from pupal chambers in Monterey Cypress (*Cupressus macrocarpa* Hartw.) near Cambria, San Luis Obispo County.

Eudistenia costipennis Fall. Linsley (1933, 1962b) records this species from Canyon Oak and Coast Live Oak. We encountered it abundantly in Canyon Oak throughout higher elevations in the San Gabriel Mountains, the larvae mining beneath the bark of trunks and larger limbs. Larval development apparently takes 2 years or more, with several instars occurring together in a single infestation. The pupal cell lies parallel to the grain of the sapwood, and is plugged to the inner bark surface with a wad of shredded frass and fine, grainy fecula. Pupation occurs in the fall, with adults overwintering in their cells. In the Sierra Nevada we found this species in the trunks of fire-killed Black Oak.

Paranoplium gracile gracile (LeConte). This species has a broad host range, our material having been reared from Greenbark Lilac (*Ceanothus spinosus* Nutt.), Laurel (*Umbellularia californica* H & A) and a cultivated species of *Acacia*.

Eburia falli Linsley. We have taken this large species throughout the Colorado and Lower Sonoran deserts of California and Arizona, with adults occasionally attracted to light. Larvae mine the heartwood of dying and dead Palo Verde (*Cercidium* sp.), usually in large limbs adjacent to still-living portions of the tree. The life cycle requires 2 or 3 years, with reinfestation of old wood frequently observed. Differing rainfall patterns in southern Arizona and southeastern California sometimes apparently create different seasons of adult activity, as our light-sample records from the Tucson area range from late June to mid-August, while adult emergence in the California deserts rarely occurs before late August or early September.

Eburia ovicollis LeConte. Linsley (1962b) records the host of this species as Ebony (*Pithecellobium flexicaule* Benth.). A single male was collected in May by F. T. Hovore as it emerged from a partially-dead branch of Mesquite (*Prosopis juliflora* Sw.) near Pharr, Hidalgo County, Texas.

Hesperanoplium antennatum (Linsley). Linsley (1962b) lists *Pinus* as the host for this species, and Tyson (1970) records it from *Cercocarpus ledifolius* Nutt. and *Salix*. We have reared it from Mountain Mahogany (*Cercocarpus betuloides* Nutt.), Toyon (*Heteromeles arbutifolia* M. Roem.), and Holly-leaved Cherry (*Prunus ilicifolia* Nutt.).

The single character used to separate *H. antennatum* from *H. notabile* (Knull), the relative angulation of the pronotal sides, varies in our material from broadly, evenly rounded to distinctly angulate. Although no constant structural characters are apparent by which the two named forms may be differentiated, the *Pinus*-associated material (presumably from the Sierra Nevada) may well represent a biologically valid species, and synonymy without further investigation would seem inadvisable.

Osmidus guttatus LeConte. Tyson (1970) records specimens of this species which had been reared from Mesquite in Death Valley, California. We encountered teneral adults in August in dead, dry branches of Palo Verde near Glamis, Imperial County, California, and numerous specimens were subsequently collected at night on this host, as well as on Mesquite and Desert Ironwood (*Olneya tesota* Gray).

Gnaphalodes trachyderoides Thomson. A single male emerged from a dead branch of Hackberry (*Celtis* sp.) collected by F. T. Hovore near Pharr, Texas. Adults are commonly attracted to light and have previously been recorded as breeding in a variety of legumes (Linsley 1962b).

Purpuricenus dimidiatus LeConte. We found the larvae of this beautiful species partially girdling the bases of small Scrub Oak trees growing on the desert slopes of southern California mountains. The larvae subsequently feed up into the weakened stem, extruding frass and fecula through an open rupture in the bark. This opening is later enlarged and then closed with a plug of fibrous frass, through which the adult emerges. Development requires at least 2 seasons, with feeding larvae and teneral adults encountered together in June.

Knulliana cincta cincta (Drury). Linsley (1962b) records this widespread species from a number of hardwood hosts. We reared a large series of adults from recently-burned Mesquite gathered near Rio Grande City, Starr County, Texas.

Knulliana cincta sonorensis (Schaeffer). A large series of this distinctive subspecies was reared from dead limb and trunk sections cut by F. T. Hovore from 2 species of oak near Fort Davis in western Texas. Although previously recorded only from southern Arizona and northern Mexico, it was abundant in the higher elevations of the Davis Mountains.

Tragidion coquus (Linnaeus). A series of this variably-colored species was collected in October by the authors and R. L. Penrose from blossoms and stems of *Senecio* sp. (prob. *longilobus* Benth.) growing along the highway north of White's City, Eddy County, New Mexico. Adults are apparently strongly attracted to exudates of this plant, feeding in a manner similar to that reported for *Stenaspis solitaria* (Say) by Linsley & Cazier (1962). *Quercus*, the only recorded larval host for this species, was not found by us to occur in the vicinity of the *Senecio* plants, and a cursory examination of several species of woody shrubs yielded no clue as to the host.

We collected numerous addititional specimens, tentatively regarded as representing an anomalous population of *T. coquus*, from Composites and

Baccharis neglecta Nutt. growing in a small arroyo 19 mi SE Dryden, Terrell County, Texas. While the majority of males have the body and appendages black (as in typical *T. coquus*), a significant number have the intermediate antennal segments broadly annulated with reddish-orange, as in *T. annulatum* LeConte and *T. auripenne* Casey. Male elytral coloration grades from fulvous, as in *T. annulatum*, to orange, as in paler *T. coquus*, but never the deep reddish-orange of *T. auripenne*. Several males have the dark basal elytral band slightly extended posteriorly near the suture, and show faint indication of an antemedian lateral pale spot, as in some *T. coquus*. Females are uniformly black with orange elytra. Also, the posterior tibiae vary from straight to distinctly sinuate, and the tibial pubescence has obscure bluish reflections, as in *T. coquus*. However, the tibia are not so strongly compressed as those of *T. coquus*, and antennal segments 3 to 6 are feebly carinate apically, 7 to 11 carinate for their entire length, as in *T. annulatum* and *T. auripenne*.

This population clearly demonstrates the very close relationships of the *Tragidion* species with costate elytra, and may well represent a hybrid or intergrade population between *T. coquus* and one of the other 2 species peripheral to its range, *T. annulatum* and *T. auripenne*.

Tragidion peninsulare californicum Linsley. The only host for this subspecies thus far recorded is Coast Live Oak (Linsley 1962b). We reared it from Canyon Oak, Scrub Oak, Chamise (*Adenostoma fasciculatum* H & A), Sugarbush (*Rhus ovata Wats.*), Lemonadeberry (*Rhus integrifolia* Nutt.), and Toyon. Adults are strongly attracted to burning vegetation, and we have observed them flying into late summer chaparral brush fires. Larvae are often abundant in charred stems of Scrub Oak, Chamise, and Sugarbush for several seasons subsequent to a fire.

Tragidion gracilipes Linsley. This rarely collected species has been recorded as occurring on Coffeeberry (*Rhamnus californica* Esch.) in California as far south as Kern County (Linsley 1962b). Several additional unusual adult records, accumulated from various sources, extend somewhat the distributional range. Unfortunately, none of these observations provide much insight into the habits of this beetle. A single male was collected by F. T. Hovore on a cup at Santa Monica Beach, possibly an adventitious emergence from driftwood, and a female was taken by F. T. Hovore on Rabbitbrush (*Chrysothamnus nauseosus* (Pall.)) foliage near Pinyon Hills, Los Angeles County. One specimen was found by D. E. Rich on *Lupinus* blossoms at 6000 feet, Mt. Pinos, Kern County, and another specimen was from inside a gymnasium in Newhall, Los Angeles County.

Amannus vittiger LeConte. We collected adults on the blossoms of Mallow (*Sphaeralcea* sp.) in June at several localities in northern Arizona and southern Utah. Although numerous bushes of *Atriplex* spp., the recorded larval host, were examined and beaten at most localities, no larvae or adults were found.

Batyle knowltoni Knull. Knull (1968) described this species from a short series of all-black specimens, collected 20 miles southeast of Escalante, Garfield County, Utah. In our long topotypical series, only one individual is predominately black. The other specimens are bright red with the sutural elytral vittae, pubescence, and appendages black.

Batyle suturalis (Say). Although Linsley (1962b) does not record this species from Arizona, we collected it in abundance on Composites and Mallow at several localities in Apache County. We have tentatively referred them to the New Mexican subspecies *rutilans* (LeConte), although some of the specimens are slightly atypical in coloration and punctation. It is apparent that *B. suturalis* is more widely distributed in this region than has been known, and more extensive collecting will no doubt lead to a taxonomic reassessment of the species. Although the nominate subspecies has been reared from numerous hardwood trees, several of the localities in northern Arizona are in open grassland, many miles from any species of recorded host plant.

Crossidius humeralis quadrivittatus Penrose. Adults were abundant in October on the blossoms of *Isocoma* (=Haplopappus) *drummondi* (T & G) Greene at Welder Wildlife Refuge, San Patricio County, Texas. The host is distributed throughout the grazed-over grassland plant associations on the refuge.

An additional short series of a phenotypically different population, apparently referable to this subspecies, was collected by R. L. Penrose and F. T. Hovore in western Texas, approximately 6 mi SE Eagle Pass, Dimmit County on *Isocoma coronopifolia* (Gray). Integumental coloration is pale reddish-brown instead of orange-yellow, the pronotal and elytral dark markings are evanescent, and the appendages are dark reddish-brown instead of black.

Crossidius militaris Bates. A series of over 50 adults was collected by the authors and R. L. Penrose on *Gutierrezia* sp. (prob. *lucida*) near White's City, New Mexico in October. Although individuals were found over a fairly wide area, they were much more abundant on the rocky hillsides than along the highway or in dry wash situations.

Deltaspis cruentus (LeConte). A series of this strongly dichromatic species was collected by F. T. Hovore and W. R. Icenogle in the rocky foothills near Winchester, Riverside County, California. All specimens were taken on the dried inflorescences of California Buckwheat (*Eriogonum fasciculatum* Benth.). A single male was collected by E. Giesbert from foliage of *Baccharis sergiloides* Gray in an arroyo near Rio San Telmo, Baja California, in August.

Parevander xanthomelas (Guerin). Linsley (1942, 1961) records the distribution of this attractive species as south and central Mexico and "from southern Mexico to Guatemala." We found it moderately abundant in October on *Verbescina encilioides* (Cav.) Benth. & Hook, in the southern Rio Grande Valley. It seems to be confined to the dry, upland areas of Hidalgo and Starr Counties, where it often occurs in company with *Mannophorus laetus* LeConte.

Chrotoma dunniana Casey. A single adult of this rarely collected species was reared by us from the root crown of living *Condalia* (prob. *globosa pubescens* Jtn.) collected 30 miles N Mojave, Kern County. Larvae mine the center of the root, constructing a large, meandering gallery which is loosely packed with fine powdery frass and fecula. Pupation occurs in an enlarged portion of the gallery which the larva seals at both ends with a tight wad of shredded frass. Adults evidently emerge at about ground level. The larval workings of this species are very similar to those of the genus *Crossidius* LeConte.

Holopleura marginata LeConte. We reared numerous specimens from dead limbs of Big-cone Spruce (*Pseudotsuga macrocarpa* Vasey) collected near Ozena, Ventura County, California. It has previously been recorded from various species of hardwoods (Linsley 1962b) and from Douglas Fir (Penrose & Westcott 1974).

Dendrobias mandibularis mandibularis Audinet—Serville. Specimens of this striking species were reared from dead branches of Hackberry collected near Pharr, Texas, and dead adults were found in decadent *Acacia* limbs near Brownsville. Pattern variation in our extensive series of material from southern Texas indicates that the subspecies *virens* Casey represents an inconsistent tendency for reduction of dark markings, primarily in males, and does not correlate with distribution or host preference.

Stenosphenus lepidus Horn. Although this species is common on flowers throughout southern Arizona, no larval hosts have been recorded. Numerous individuals were collected by the authors from dead branches of Hackberry in July in the Santa Rita Mountains, and several specimens have subsequently been reared from this host.

Stenosphenus texanus Knull. Adults of this species were beaten from branches of willow and collected from blossoms of *Acacia* and *Baccharis* by F. T. Hovore in the Davis Mountains, Texas. Several females were also taken sitting upon a branch of Mesquite, and a single male was cut from its pupal chamber in the branch.

Enaphalodes seminitidus (Horn). We have taken a large series of adults of this shining species at night from the trunks of declining Mesquite trees near Tucson, Arizona. Older trees display extensive cerambycid larval workings, probably primarily of this species, although several specimens of *Aneflus paracalvatus* Knull were also taken on the trees.

Eustromula validum (LeConte). This species has previously been recorded from *Prosopis*, *Cercidium* and *Parkinsonia* (Linsley 1963), and to this group may be added *Salix* sp. We found it locally abundant on the trunks and under bark of dying and dead willow trees along the Colorado River near Yuma, Arizona.

Anelaphus inflaticollis Chemsak. Larval work of this interesting species is widespread in Crucillo (*Condalia* sp.) bushes in the high desert regions of northeastern Los Angeles County. Larvae hollow-out the stems of their host, expelling frass and fecula through a linear series of round holes, thereby giving dead twigs a flute-like appearance. Prior to pupation, the larva chews a saddle-shaped girdle in the stem and retreats into a long pupal chamber below the girdle. Exposed girdles are tightly plugged with a wad of shredded frass. Pupation apparently occurs in the fall, and we collected teneral adults from their cells in January.

This species is closely related to *Anelaphus brevidens* (Schaeffer), from which it may be distinguished by the inflated pronotum of the male, shorter antennae in both sexes, and finer, less dense elytral punctation. Chemsak (1959) records the sex of the holotype as female, due to the very short antennae and generally broad facies. It is more likely a male, however, as females do not have an inflated-appearing pronotum, and have the antennae only about 1/2 as long as the body.

Anelaphus debilis (LeConte). This species was reared by us from dead Mesquite collected north of Rio Grande City, Starr County, Texas. The wood, once part of a fence, was heavily infested with bostrichid beetles, and the heartwood displayed past larval work of *Callona rimosa* (Buquet). Other longhorn species also reared from this wood were *Knulliana cincta*

cincta, Stenosphenus dolosus Horn, *Placosternus difficilis* (Chevrolat), and *Heterachthes nobilis* LeConte.

Anelaphus moestus moestus (LeConte). Linsley (1963) records the host of this species as *Juglans nigra*. A short series was beaten and reared by F. T. Hovore from dead oak in the Davis Mountains of western Texas.

Anoplocurius incompletus Linsley. A single female was collected at light by the authors in a dry wash 6 mi E Glamis, Imperial County, California. Linsley (1942) described this diminutive elaphidionine from a unique pair collected in southern Baja California.

Poecilobrium chalybeum (LeConte). We beat several specimens of this small, blue species from Mountain Mahogany blossoms, 3–5 mi S Fort Wingate, McKinley County, New Mexico. *Cercocarpus* is a new floral host, and the locality is a significant extension of the known range in the Rocky Mountain region. It was previously recorded from as far south as Colorado (Linsley 1964).

Molorchus longicollis (LeConte. This variable species is known to breed in a variety of hardwood shrubs, but Hardy & Preece's rearing record from Douglas Fir (1927) has long been considered an identification error. We have, however, reared *M. longicollis* from small branches of Douglas Fir gathered at Santa Rosa, Sonoma County, California, and from twigs of White Fir (*Abies concolor* Gord. & Glend.) in company with *M. eburneus* Linsley in the San Gabriel Mountains.

Molorchus bimaculatus californicus Linsley. This subspecies was reared by F. T. Hovore from dead Greenbark Lilac twigs collected in Placerita Canyon, Los Angeles County, and adults are often taken in spring on the blossoms of this plant. A single male, collected by F. T. Hovore in the Santa Monica Mountains, Los Angeles County, and apparently referable to this subspecies, has the integument wholly piceous.

Phymatodes decussatus decussatus (LeConte). This species has previously been recorded only from various species of oak, in which it is often very abundant. We reared a series from dead willow branches from Fort Tejon, Kern County, in company with *Phymatodes blandus blandus* (LeConte). No constant differences are apparent between our willow-reared material and those specimens examined from oak. The characters cited by Linsley (1964) for recognition of *P. decussatus australis* Chemsak are extremely variable in material from both hosts, and it is probable that this subspecies is only a pattern variety within the nominotypical populations.

Phymatodes vilitatis Linsley. This species, which commonly bores in smaller branches of Douglas Fir, was beaten by F. T. Hovore from White Fir in the Sierra Nevada near Lake Tahoe, and reared from Santa Lucia Fir (*Abies bracteata* D. Don) from Monterey County, California.

Placosternus erythropus (Chevrolat). This species is recorded (Linsley 1964) from the United States from but a single specimen from Alpine, Texas. We found it abundant and widespread in October in several different plant associations in western and southern Texas. Adults were collected from numerous species of flowering plants in a grove of *Sabal texana* Bece. near Brownsville; from *Condalia* blossoms in the dry uplands near El Sauz, Starr County; and from *Baccharis neglecta* at both Welder Wildlife refuge and 19 mi SE Dryden.

Tanyochraethes tildeni Chemsak and Linsley. Numerous adults were collected by the authors and R. L. Penrose from inflorescences of *Eriogonum multiflorum* Benth., 25 mi S Sarita, Kenedy County, Texas. No larval work was found in the roots of the *Eriogonum,* and it is probable that it is used only as an adult feeding or congregating host.

In our series, the amount of elytral pubescence is quite variable, often obscuring one or more of the normally denuded areas which comprise the pattern.

Triodoclytus lanifer (LeConte). Linsley (1964) records the hosts of this species as *Sambucus, Rhamnus* and *Pickeringia.* We reared it from dry, dead branches of Canyon Oak collected in the San Gabriel Mountains. Larvae construct long, meandering galleries down the center of the branch, similar to those of immatures of the tribe Purpuricenini. Larval development apparently extends over a considerable period of time, one specimen having emerged from wood which had been enclosed in a rearing container for over five years.

Xylotrechus sagittatus chiricahuae Chemsak. Pupae and teneral adults were cut by us from the lower trunk of a two-year dead coniferous tree (prob. *Abies* sp.) in the Huachuca Mountains. It was previously recorded only from *Pinus chihuahuana* in the Chiricahua Mountains, Cochise County, Arizona.

Xylotrechus quercus Schaeffer. A long series of pupae and adults was collected by F. T. Hovore and D. G. Marqua in and under the thick bark of a standing dead oak tree near Peña Blanca Lake in southern Arizona. Larval habits are very similar to those of *X. nauticus* (Mannerheim) as summarized by Linsley (1964).

Rhopalophora angustata Schaeffer. Large numbers of this rare species, plus several specimens of *R. laevicollis* (LeConte) were beaten by R. L. Penrose and the authors from foliage of *Baccharis neglecta* and dead branches of *Celtis* and *Pithecelobium* at Welder Wildlife Refuge in early October.

Rhopalophora prorubra Knull. We collected a number of specimens of this peculiar Arizonan species from blossoms of *Condalia* in the Santa Rita Mountains in July. It has also been taken from blossoms of Mulefat (*Baccharis glutinosa* Pers.) by E. Giesbert and from *Mimosa* sp. by A. E. Lewis in Box Canyon, Pima County.

Rhopalophora longipes meeskei Casey. Although adults of this subspecies are commonly collected from flowers, nothing has been recorded regarding possible larval hosts. A single male was taken from its pupal cell in *Pinus* sp. in the Chiricahua Mountains (C. E. Langston, pers. comm.), and a mating pair was beaten from *Pinus cembroides* Zucc. by F. T. Hovore in Big Bend National Park, Texas.

Rhopalophora bicolorella Knull. Specimens apparently referable to this variable species were beaten and reared by us from twigs of willow at Amado, Santa Cruz County, Arizona. The willow-associated specimens differ from typical *bicolorella* in that the head is entirely reddish, thereby running them to *R. angustata* in Linsley's (1964) key. They do not, however, agree with our long topotypical series of that species, and seem to be structurally closer to *bicolorella* than to any other described species. There appears to be some overlapping of pronotal and elytral characters between species, and more host-associated material, particularly from northern Mexico, is needed to help clarify relationships in this section of the genus.

LAMIINAE

Trichastylopsis albidus (LeConte). We have beaten and reared this cryptically-colored species from Cottonwood (*Populus fremonti* Wats.) at Yuma, Arizona. It has previously been recorded only from southeastern Arizona and New Mexico (Dillon, 1956). It may, however, be much more widely distributed than has been assumed, as C. E. Langston (pers. comm.) has taken what he believes to be this species on Cottonwood near Bakersfield, Kern County, California.

Astyleiopus variegatus (Haldeman). A single specimen of this common eastern species was taken at light in Madera Canyon, Santa Cruz County, Arizona, by F. T. Hovore in July. Dillon (1956) lists the westernmost localities as College Station, Texas and Salt Lake City, Utah. The Arizona specimen does not appear to differ significantly from eastern material examined.

Sternidocinus barbarus (Van Dyke). We reared a large series of this rare species from thick bark of dead Coast Live Oak collected in the San Gabriel Mountains. Larvae mine the cambium layer and inner bark surface, packing their flat, meandering galleries with fine, shredded frass. Prior to pupation, the larva constructs an oval pupal cell up inside the bark, similar to those constructed by members of the genus *Acanthocinus*. Additional specimens, collected at light, have been seen from the Santa Monica Mountains.

Lochmaeocles marmoratus Casey. This spectacular species is sporadically abundant in the major watersheds of southern Arizona. We have observed larval work in willow and cottonwood near Nogales, Amado and Green Valley along the Santa Cruz River, and along the San Pedro River in Cochise County. We collected a large series of adults from willow in the San Bernardino watershed east of Douglas as they crawled about the branches and trunks, and J. N. Knull (pers. comm.) took a series at a kerosene lantern trap, 5 mi N Nogales. A detailed and accurate account of the habits of this species has been published by Smyth (1934).

Tigrinestola tigrina (Skinner). Chemsak & Linsley (1966) record this species as having been beaten from oak and reared from Palo Verde (*Cercidium torreanum*) in southern Arizona, where it is also commonly taken at light. We collected numerous specimens in company with *Poliaenus negundo* (Schaeffer) while beating dead branches of Box Elder (*Acer negundo* L.) in the Huachuca Mountains.

Tetraopes linsleyi Chemsak. We collected a small series of adults from stems of *Asclepias subverticillata* (Gray) in Miller Canyon, Huachuca Mountains. Although both *T. discoideus* LeConte and *T. femoratus* LeConte were found on *Asclepias* plants growing nearby, neither occurred in the small stand in which the *T. linsleyi* were found. Nor were any *T. linsleyi* encountered in adjacent stands of milkweed, although considerable effort was made to locate additional specimens. The plants upon which they were taken were growing in a well-drained, loosely-compacted, rocky soil, while most other milkweed stands were in moist depressions along roads or in drainage canals. It is probable that the larval moisture requirements of *T. linsleyi* differ considerably from those of other *Tetraopes* species, as most locality records are from somewhat higher and generally drier areas than are typical for the genus.

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* * *

DESIGNATION OF A TYPE-SPECIES FOR *EFFLAGITATUS* PACHECO (COLEOPTERA: HETEROCERIDAE)

The generic name *Efflagitatus* was proposed in 1964 by Pacheco for a group of 7 species to which an eighth was added in 1969. All of the originally included names are valid and eligible to be designated as type-species, but through an oversight, a type-species was not designated. I hereby designate *Heterocerus assimilis* Grouvelle as type-species because it is the oldest name among those included.

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* * *

THE SOUTHERN POTATO WIREWORM IN CALIFORNIA (COLEOPTERA: ELATERIDAE)

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Abstract

The southern potato wireworm (*Conoderus falli* Lane), a destructive pest of vegetable crops in southeastern U. S., has been present in southern California since 1963. Preliminary findings indicate that the times of beginning and peak adult emergence and the duration of stages compare favorably to results obtained in studies in the southeast. The species appears to be well adapted climatically to southern California.

The southern potato wireworm *Conoderus falli* Lane is a destructive pest of potatoes, tobacco, and vegetable crops in southeastern U.S. Progress in the control of this pest has been slowed due to its resistance to certain soil insecticides (Reid and Cuthbert 1956). In California adults of this species were first collected in May 1963 by E. I. Schlinger in Deep Canyon near Palm Desert, in an area with desert type vegetation (Stone 1975). They were collected in June at Cathedral City and at Indio and Riverside in 1966. In addition to the above localities, all in Riverside County, adults have been received from Orange, San Diego, and Fresno counties.

In the southeastern U. S., *C. falli* occurs in all coastal states from Virginia to Texas (Stone 1975). The biology of this insect in the southeastern states has been studied in great detail by Day *et al.* (1971). Its presence in Riverside permitted me to obtain preliminary data on seasonal abundance and the effects of possible climatic change on the biology of this insect in California.

Catches of *Conoderus falli* adults at light (1973-76)

Data on adult activity were obtained from a 15 watt fluorescent black light located on the back of a building adjacent to a bare field formerly planted to citrus. Adults were collected nightly usually between 8 and 9 p.m. In 1973 adults were active in the period May 27 to October 17 and were most numerous in September. In 1974 adults appeared on May 15, reached a peak in August, and ceased activity October 18. In 1975 first and last collections were made on May 1 and October 5. Most of the beetles were collected in July and August. The earliest catch of adults at light occurred April 30, 1976 when day temperatures reached 90°F. Five of the 7 adults collected were females.

The above data were based on collections of 302, 436, and 440 adults in the years 1973-75 inclusive. The catches of adults on a monthly basis are shown in fig. 1.

Collections of adults nightly varied depending upon temperature. Only 1 or 2 adults were collected all evening at temperatures of 65°, whereas at 78°F. as many as 39 adults were taken in a few minutes. In light trap studies by Day *et al.* (1971) in South Carolina, in areas of excessively high populations the largest catches of adults were obtained in July and August as was true in Riverside.

LIFE HISTORY STUDIES

The duration of the larval period of *C. falli* was determined by confining newly hatched larvae individually in 2 ounce salve tins in moist 30 mesh soil, with from 2 to 5 kernels of wheat depending upon size; food was replenished at 2 week intervals. The larvae were confined indoors where temperatures varied from 65 to 78°F.

Of 27 larvae which hatched August 15, 1975, 22 pupated the same year between October 6 and November 21. In this group the pupae transformed to adult between October 20 and December 9. The larval period ranged from 52 to 98 days, averaging 74 days. The pupal period varied from 15 to 18 and averaged 16 days. The 5 remaining individuals in this group pupated the following year between May 26 and July 5, 1976. The larval and pupal stages averaged 308 and 14 days respectively. In southern potato wireworm rearings at Charleston, S. C. (Day *et al.* 1971), fewer (15 to 18%) of August hatched larvae matured the first year.

In the southeast, larvae hatching late in the season, after September, usually overwinter and mature the next spring or summer. To determine if larval development was affected similarly in Riverside, a group of 21 larvae which hatched late, on October 8, 1975, were reared on wheat as described previously. The results showed a similar trend in that 38% of the larvae completed development in May, 43% in June, and 19% in July of the following year.

In this late hatch group the larval stage ranged from 175 to 281 and averaged 244 days. The pupal period ranged from 15 days in May to 10 days in July and averaged 13 days.

LONGIVITY OF *C. falli* ADULTS

Adult longevity was determined by confining laboratory reared adults in glass jars with thin slices of carrot which were renewed at weekly intervals. Of 6 adults which had transformed November 7, 1975 and which were confined as above, one died 5.8 months later on April 29. Three died in May and two on June 22 after 7.6 months in the adult stage. Of the many elaterids reared by me, this species has by far the longest active adult stadium.

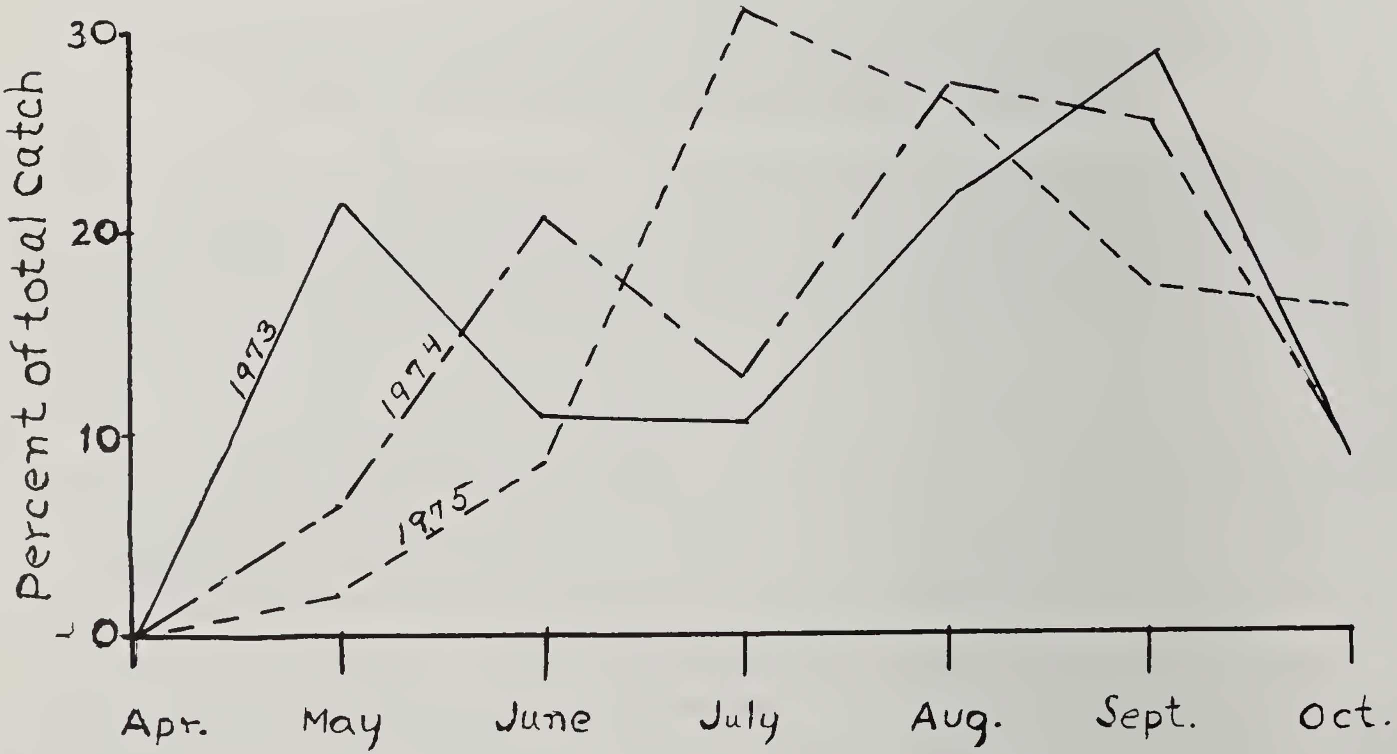

Fig. 1. Monthly catches of *Conoderus falli* adults at black light, Riverside, CA, 1973-75.

Preliminary findings concerning emergence and time of beginning and completion of stages of the introduced southern potato wireworm in California compare favorably to findings in the southeastern states. The species appears to be well adapted climatically to this area and only time will determine its destructiveness.

ACKNOWLEDGMENTS

My thanks to J. Wilcox for his interest and helpful suggestions and for operating a light trap and collecting elaterids at Olive (Orange Co.). Thanks also to Saul Frommer, University of California, Riverside, for his critical review of the manuscript.

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DAY, A., F. P. CUTHBERT, JR., AND W. J. REID. 1971. The southern potato wireworm. USDA Tech. Bull. 1443:1-33.

REID, W. J., JR. AND CUTHBERT, F. P., JR. 1956. Resistance of the southern potato wireworm to insecticides. J. Econ. Ent. 49:879-880.

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* * *

COLEOPTERIST NEWSLETTER

The **Newsletter** has been reinstated by a very large majority of the voting membership (134 in favor, 13 against).

Once again I ask for your support in making the **Newsletter** the kind you want. Send articles and news to be included, eg. techniques, field trip notes, general notes on biology, news about Coleopterists, etc.

We will publish in the *Bulletin,* with the **Newsletter** clearly labelled. Frequency will depend on amount of material submitted. I shall look forward to hearing from you as it is your **Newsletter** and depends entirely on you and your support.

—Charles W. O'Brien, Editor
Laboratory of Aquatic Entomology,
P. O. Box 111,
Florida A and M University,
Tallahassee, Florida 32307

* * *

THE OCCURRENCE OF A TROGLOPHILIC GROUND BEETLE IN FLORIDA (COLEOPTERA: CARABIDAE)

PAUL M. CHOATE AND THOMAS ROGERS

Dept. of Entomology, University of Florida Gainesville, FL 32601

ABSTRACT

Platynus (*Rhadine*) *jonesi* (Barr) is recorded from Florida for the first time. Also included is a list of other Carabidae collected at the same locality.

Barr (1960, 1974) revised members of subterranean ground beetles of the genus *Rhadine* LeConte. Whitehead (1973) treated *Rhadine* as a subgenus of *Platynus* Bonelli. We follow the classification of Whitehead here.

A collecting trip to northern Florida was undertaken by the authors on 25-VI-1976. Many species of Coleoptera were collected during this trip; most unexpected, however, was the capture of a single female *Platynus jonesi* (Barr) by Tom Rogers.

We arrived at the Apalachicola River west of Bristol, Florida at approximately 2:30 a.m. Access to the river was by means of a side road leading south from the Calhoun Bridge on the Bristol side of the river. Several roadside pulloffs were found and collecting was done 0.7 miles from the main road (FL Rt. 20). The heavily eroded river banks were composed of clay and sand. Extensive root systems often reached the water's edge, making walking along the shoreline difficult. Beetles were collected by headlamp.

The specimen of *P. jonesi* was near the water's edge and ran rapidly as soon as the light from the headlamp struck the shoreline. Further searching along the river banks failed to yield more specimens of *Platynus jonesi.* Although the beetle was collected some 15 feet from the steep clay banks, it is quite likely that the true habitat is to be found in the extensive crevices in the clay banks. Other species of Carabidae collected at the same time were: *Omophron labiatum* F., *O. americanum* Dej., *Aspidoglossa subangulata* (Chaud.), *Ardistomis puncticollis* (Dej.), *Tetragonoderus fasciatus* Hald., *Chlaenius aestivus* Say, and *C. erythropus* Germ.

P. jonesi was described from Turk's Cave, near Brooklyn, Alabama. This site is approximately 75 miles northwest of the collection site in Florida, suggesting that this species should be looked for along the larger river systems of Florida.

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WHITEHEAD, DONALD R. 1973. Annotated key to *Platynus*, including *Mexisphodrus* and most "*Colpodes*", so far described from North America including Mexico. (Coleoptera: Carabidae: Agonini). Quaest. Ent. 9:173-217.

* * *

CORRECTION

Due to a purely editorial blunder, the heading at the top of page 294 in the September issue was printed with an incorrect spelling. This heading should read "*Calosoma cicatricosum balli* Rotger, **new subspecies**". I guarantee this type of error will not occur again. Meanwhile, I sincerely apologize to Padre Rotger.

—D. R. Whitehead

A NEW SPECIES OF *ANOMALA* SAMOUELLE FROM CALIFORNIA SAND DUNES

Alan R. Hardy

Insect Taxonomy Laboratory
California Department of Food & Agriculture
Sacramento, CA 95814

Careful observations by Dave Carlson and Paul Ritcher at Oregon State University revealed a second species in a series of *Leptohoplia testaceipennis* Saylor. Examination of additional material revealed that nearly every series of *Leptohoplia* contained this mimetic taxon in rather large numbers. Further examination indicates that 2 genera are involved, *Leptohoplia* and a new species of *Anomala*, described below. The differences between these 2 genera have been recently discussed by Potts (1974; Pan-Pacific Entomol. 50:148-154).

I would like to thank R. W. L. Potts, Coarsegold, California for his comments upon the relationships involved; F. G. Andrews, California Department of Food and Agriculture; and R. Schuster, University of California at Davis for the Scanning Electron microscope photographs. I would like to thank H. F. Howden (HFH), D. Marqua, R. Westcott, P. O. Ritcher (OSU), R. W. L. Potts, S. Frommer (UCR), F. Hovore, and F. G. Andrews (CDA) for the loan of specimens.

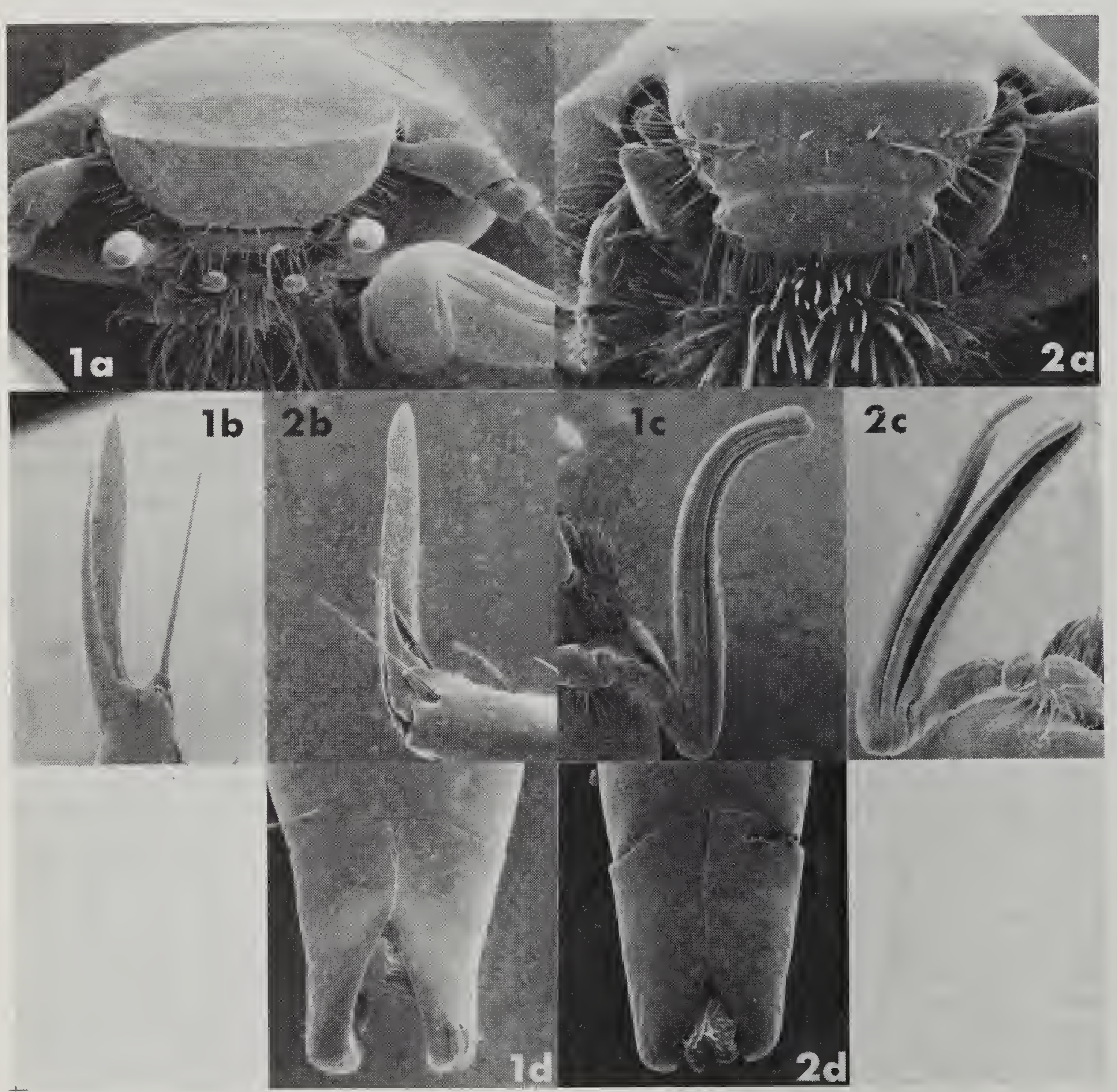
Anomala carlsoni Hardy, **new species**

Holotype male. Length 7.6 mm, width of prothorax 2.7 mm. Head dorsally pale red-brown, eyes black, posterior tarsi and tibial apices pale red-brown, rest of body straw yellow. Clypeus concave, parallel sided; anterior clypeal face produced, visible from above; clypeal width greater than length (3:2 ratio). Dorsal surface glabrous except for few fine, erect hairs at inner margin of eyes; clypeus at front very finely punctate with scattered punctures. Antennae 9-segmented, club 3-segmented, over twice length of basal segments (Fig. 1c). Eyes large, globose. Labrum anteriorly produced; distinctly separated from clypeus by deep groove. Labium tumid, provided with numerous long erect hairs. Mentum narrow, globose, palps inserted medially, at tip. Prothoracic length ca. 0.7 times width. Prothorax provided with scattered fine punctures. Semi-erect pale hair mainly confined to posterior or lateral parts of pronotum, posterior and lateral edges with reflexed marginal bead. Posterior thoracic angles broadly rounded, anterior angles obtuse. Scutellum nearly glabrous, rounded posteriorly. Elytra with lateral posterior 2/3 with row of numerous hairs just inside membranous border; intervals plane; striae present only as single row of fine punctures, some punctures each provided with short, fine, erect hair. Pygidium margined posteriorly; long hairs on disc, becoming denser apically. Ventral surfaces with scattered recumbent to erect, short to long, pale hairs. Six visible abdominal sternites. Anterior tibia bidentate; larger anterior and medial claw cleft. Posterior tibia with 2 incomplete carinae ventrally. Posterior tibial apex with short to long spines; corbel prominent. Posterior claws unequal, smaller over 1/2 length of larger (Fig. 1b).

Allotype female. Length 7.04 mm, width of prothorax 2.45 mm. Differs from Holotype as follows: Eyes smaller, not globose; head and prothorax more coarsely punctured; antennal club small, no longer than basal segments. Ventral surfaces more densely clotted with fine, pale erect hair. Anterior tarsal claw small, reduced; width of posterior tibial apex 1/2 tibial length. More globose in overall appearance.

Paratypes. Length 5 mm to 8.5 mm, width of prothorax 1.8 mm to 3 mm. Agree well with type. Male genitalia, fig. 1d.

Type material: Holotype, Allotype, and 811 male Paratypes. Holotype (CAS# 12427) and 3 male paratypes; California, Imperial Co., 2 mi. NW Glamis, II-27-1972 (ARH). Allotype (CAS) and 200 male paratypes; California, Imperial Co., 3 mi. NW Glamis, IV-9-1972 (ARH). Six hundred eight other male paratypes: CALIFORNIA, *Imperial Co.*, Glamis; V-5-1970 (5 ARH, HFH); IV-12-1969 (1 ARH); IV-16-1972 (3, Hovore); III-26-1972 (7, Marqua); IV-23-70 (1, ARH); 1 mi. W. Glamis, IV-7-1971 (4, Westcott, OSU); 2 mi. W. Glamis, V-2/4-1973 (259, OSU); 3 mi. NW Glamis, IX-16-1972 (4, ARH); III-4-1972 (23, ARH); III-24-1972 (97, ARH) IV-7/9-1972 (196, Potts); 3.5 mi. NW Glamis, III-10-1972 (6, CDA); 10.7 mi. W Glamis (1, UCR). ARIZONA, *Yuma Co.*, Yuma, IV-3-1954 (1, HFH). Specimens additionally will be deposited in USNM and LACM.



Figs. 1 (*Anomala carlsoni*) and 2 (*Leptohoplia testaceipennis*): a, Clypeal face, showing free (1a) or fused (2a) labrum; b, Posterior tarsal claws; c, Antennae, showing ratio of basal segments to club length; d, Male genitalia.

In most Anomaline the mentum is broad anteriorly, with the palps inserted on the outer apical angles. In *A. carlsoni* the mentum is quite narrow and globose, with the palps inserted close together at the apex. *Leptohoplia* also has a mentum that is narrower than that typical for most Anomalini, but not as narrow as the mentum of *A. carlsoni.* A similar demonstration of the narrow mentum may be seen in some species in the "*Rhombonalia*" section of the genus, where this species probably should be placed, although it lacks the cleft tarsal claw.

This species appears to be easily recognized among North American *Anomala.* The small size, parallel-sided shape, and pale coloration make it distinctive. It is most likely to be confused with *Leptohoplia testaceipennis*, a sympatric species of similar size, shape, and coloration. It is distinguished from *Leptohoplia* by the free labrum (Fig. 1a), longer posterior tarsal claw (Fig. 1b), and the approximate ratios of the basal segments of the antennae to the club (Figs. 1d, 2d).

* * *

EDITORIAL: ADMISSIONS AND ACKNOWLEDGMENTS

In this first year as editor of the *Bulletin,* I have made some strides toward learning the job, but not without making many errors of mechanics, judgement, and timing. One thing I have learned is just how time-eating the job is; my intention originally was to stick it out for 5 years, but now I do indeed believe I would be pleased to surrender my post should someone express a sincere interest!

With the vigorous cooperation of the Storter Printing folks, we are making a crash effort to produce this issue on time, to be in the mail by the end of the year. Hence, this issue is unusually small, and some articles promised for this issue must wait til March. I can promise an extra large issue then, in compensation.

I am extremely indebted to Bob Woodruff for continuing to serve as "Acting Managing Editor", helping with numerous details best accomplished in Gainesville. I also am pleased to acknowledge Paul Shubeck for providing all of the literature notices that appeared in 1976.

One of the most arduous and thankless tasks in preparing manuscripts for printing is the good, critical outside review. For their excellent services, I heartily thank George Ball, Wayne Clark, Art Cushman, John Doyen, Mike Druckenbrod, Ginter Ekis, Terry Erwin, Bob Gordon, Tom Hlavac, Dan Janzen, John Kingsolver, John Lawrence, Paul Spangler, Ted Spilman, Chris Thompson, George Vogt, and Dick White.

To these and all other contributors, thanks.

—D. R. Whitehead

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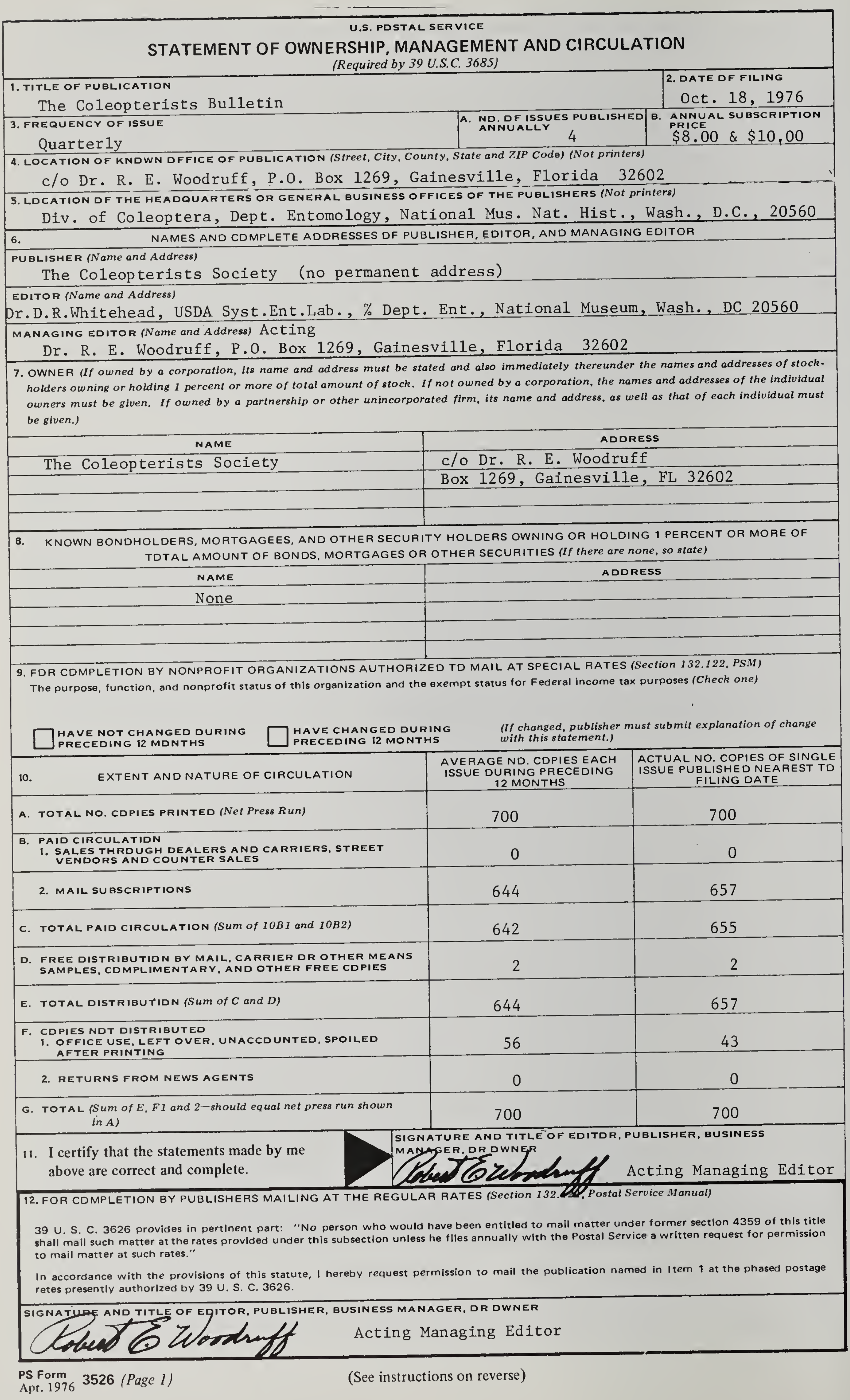

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PS Form 3526 *(Page 1)*
Apr. 1976

(See instructions on reverse)

(*Continued from inside front cover*)

departments, provinces, parishes, and/or counties listed. Dates are listed by day, month (in Roman numerals), and last 2 digits of the year. Listing of ecological data is encouraged. Location of specimens should be shown in brackets; if the data is extensive these should be abbreviated as shown and the abbreviations listed in the text.

Any article concerning Coleoptera will be considered. Descriptions of new taxa must contain keys (or be correlated with existing keys) and illustrations. All manuscripts should be typed on 8½×11" opaque white paper with 1 inch margins. They should be typed on one side only and double spaced throughout (including title, footnotes, tables, figure legends, and references). All scientific names should be underlined. Use the following order: title, author, author's address, abstract, body of text, references cited, and figures. All footnotes, tables, and figure legends should be provided on separate sheets and double spaced. Indicate approximate figure and table locations in pencil in the margin of the manuscript.

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NOTICES

Notices to appear on this page are a free service to members and subscribers. Such copy will be limited to the back page, the older notices being moved up and replaced with the newest ones at the bottom. The editor reserves the right to reword such notices for brevity, consistency, and clarity.

SCARABAEIDAE: Want to purchase ***Dynastes tityus*** and ***Plusiotus*** from North and Central America or trade for ***Psalidognathus superbus*** and French Scarabaeidae. T. D. Haas, 97 Barnes St., Long Beach, N. Y. 11561.

BUPRESTIDAE: Buy, exchange, determine Central American Agrilinae for revisionary studies. Henry A. Hespenheide, Dept. Biology, Univ. California, Los Angeles, California 90024.

CERAMBYCIDAE & HISTERIDAE: Respectively wish *Eburia* (regional studies) and *Plegaderus* (World revision); all stages. Robert H. Perry, 118 Pilgrim Ct., Bolingbrook, Ill. 60439.

SCARABAEIDAE: Would like to purchase or trade for various species of *Plusiotus, Megasoma joergenseni, M. janus* v. *argentina, Dynastes hercules* v. *equatoriana, D. satannae, Parachrysina truquii, Chrysina karschi, C. modesta, Homoiosternus beckeri, Heterosternus ludeckei, H. oberthuri.* T. W. Taylor, 8529 Norwood Pl., Rosemead, CA 91770.

WANTED: Carabidae *larvae*. Studying the phylogeny of the tribes Morionini, Pterostichini, Agonini, and Amarini as a thesis problem. Request loans, will sort. Contact for further information and/or send to Raymond G. Thompson, Dept. Ent., Univ. of Arkansas, Fayetteville, AR 72701. 501/575-2451.

STAPHYLINIDAE: If anyone wishes to send us unsorted Staphylinidae in 70% alcohol we will *eventually* return 1 or 2 specimens mounted, labeled and identified to the nearest possible taxon. Ecological data particularly desired. Ian Moore, Div. Biological Control, Univ. of California, Riverside, CA 92502.

SCARABAEIDAE: Studying myrmecophilous and termitophilous Aphodiinae. Request loan of New World material especially. Will sort from general scarab collections or from light trap samples. Robert E. Woodruff, Fla. Dept. Agr., P. O. Box 1269, Gainesville, FL 32601.

FOR SALE: 6m × 2.5m linear MALAISE TRAPS. Collecting heads utilize cyanide &/or alcohol. Proven design used worldwide. Additional information & prices write D. A. Focks, P. O. Box 12852, Gainesville, FL 32604.

EXCHANGE: Fernando Angelini, Via Imperiali "Villa Italia" n. 189/1B,72021 Francavilla Fontana (Brindisi), ITALY, wishes to receive Haliplidae, Dytiscidae, and Gyrinidae of North & South America in exchange for Coleoptera of same or other families from Italy.

EXCHANGE: Coleoptera of all Families from Arizona; ask for List and send yours. Dr. Rudolph Lenczy, 126 Los Robles, Green Valley, Arizona 85614.

LATHRIDIIDAE: Want specimens from entire world; exchange specimens, literature, and experiences. Jurgen Otto, 4006 Erkrath Kirchstr. 36—West Germany.

PUERTO RICAN COLEOPTERA: Building reference collection; need determiners (can keep duplicates). Will also exchange. Julio Micheli, 14 Baldorioty St., Mariani, Ponce, Puerto Rico 00731.

LUCANIDAE: Buy, sell, exchange all species. Also want collection data and world literature on the family. Bill E. Gavin, 981 N. W. Circle Blvd. #1, Corvallis, OR 97330.

CARABIDAE: Have *Calosoma (Carabominus) asper* Jeannel & *C. (Blapstoma) chihuahua* Gidaspow for exchange. I want *Carabus,* Cychrini, or *Calosoma* not represented in my collection. B. Rotger, Pagosa Springs, Colo. 81147.

RHYSODIDAE: Wanted, for world-wide revision. Willing to identify and return or exchange for U. S. Carabidae. Ross T. Bell, Zoology Dept., University of Vermont, Burlington, VT 05401, U.S.A.

SCARABAEIDAE: Working toward a general revision of the Anomalinae of Mexico, Central, and South America. Specimens and records needed by loan, purchase, or exchange. Identifications by arrangement. Robert W. L. Potts, California Acad. Sci., Golden Gate Park, San Francisco, CA 94118.

CHRYSOMELIDAE (ALTICINAE): Reworking manuscript revision of the maculate species of *Phyllotreta* of the U. S. and Canada for publication (includes the normally immaculate *P. denticornis, P. decipiens,* and *P. d. ordinata*). Request loan of such material immediately. Eric H. Smith, Division of Insects, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

MELOIDAE: Revising the genus *Gnathium* (Nemognathinae). Request loan of specimens from all areas, Mexican material being particularly welcome. Wilbur R. Enns, 1-87 Agriculture Building, University of Mo., Columbia, MO 65201.

DETERMINATIONS DESIRED: Blacklight trap operated year-round in Puerto Rico. Advise your interest, and if it appears I will send it to you in 70% alcohol in return for mounting and ID. You keep duplicates. H. L. Murphy, Calle 21 Sur #0-1, Bayamon Gardens, Bayamon, PR 00620.

SCARABAEIDAE: For sale or trade—specimens of *Goliathus cacicus, G. regius,* and occasionally *G. atlas* and *G. albosignatus*; wanted—other African Cetoniinae and Lucanidae. Write for prices and specific desiderata. Chris Adamson, 2437 Warring #G, Berkeley, CA 94704.

PEDILIDAE: Revising North American species of *Pedilus*. Request loan of determined and/or undetermined larvae and adults from any area. Also interested in bionomics of group, correspondence welcome. Daniel K. Young, Dept. Ent., Michigan State Univ., East Lansing, MI 48824.

CICINDELINAE CATALOGUE WANTED: Coleopterorum Catalogus #86, W. Horn, 1926. H. Boyd, Oak Shade Rd., Tabernacle Twp., RD 4, Vincentown, NJ 08088.

CERAMBYCIDAE: Need *Derancistrus* spp. from all areas for study. Will buy or exchange. Julio Micheli, 14 Baldorioty Str., Mariani, Ponce, PR 00731.

AVAILABLE FREE: Werner, Enns, Parker, "The Meloidae of Arizona", TB 175 (1966) and Butler & Werner, "Distrib. and Host Plants of May Beetles in Arizona", TB 147 (1961). Floyd G. Werner, Dept. Ent., Univ. Arizona, Tucson, AZ 85721.

705
B v.31 no.1 Biol.

THE COLEOPTERISTS BULLETIN

AN INTERNATIONAL JOURNAL DEVOTED TO THE STUDY OF BEETLES

Volume 31, No. 1 **March, 1977**

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THE COLEOPTERISTS BULLETIN 31(1), 1977

CLASSIFICATION OF THE WEEVIL SUBFAMILY TYCHIINAE, WITH A NEW GENUS AND SPECIES, NEW COMBINATIONS, AND NEW SYNONYMY IN LIGNYODINI (COLEOPTERA: CURCULIONIDAE)

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Abstract

Thysanocnemis LeConte is placed in synonymy with *Lignyodes* Dejean, and *L. slovacicus* Dieckmann is placed in synonymy with *L. bischoffi* (Blatchley). The monobasic genus *Rosella* and its type-species *R. sickingiae* (Costa Rica and Guyana, in fruits of *Sickingia maxonii* Standley, Rubiaceae) are described by Whitehead as new. The subfamily Tychiinae is classified as 4 tribes: Tychiini, Lignyodini, Endaeini, and Elleschini. Lignyodine genera are keyed and illustrated. *Neotylopterus graphicus* (Casey) and *N. yavapaiensis* (Sleeper) are new combinations, transferred from *Thysanocnemis*.

Introduction

Kissinger (1962) listed characters by which *Tychius* Germar, *Sibinia* Germar, *Paragoges* LeConte, *Miccotrogus* Schönherr, *Mecynopyga* Pierce, and *Itychus* Kissinger are distinguished from *Chionanthobius* Pierce, *Elleschus* Stephens, *Hamaba* Casey, *Neotylopterus* Hustache, *Plocetes* LeConte, *Proctorus* LeConte, and *Thysanocnemis* LeConte. Later (1964) he restricted Tychiinae to include only the former 6 genera by transferring the others, along with *Ochyromera* Pascoe and *Euclyptus* Dietz, from Tychiinae to the tribe Endaeini in the subfamily Anthonominae. Burke (1973:179), however, listed characteristics distinguishing anthonomines from some endaeines and later (1976:285) excluded Endaeini from Anthonominae. Thus, the status and placement of Endaeini (*sensu* Kissinger) were left in question.

Our interests in endaeine relationships arose independently: Clark, to find the sister group of Tychiinae (*sensu* Kissinger); Whitehead, to describe and place a new genus and species from tropical America; and Warner, to determine the status of *Euclyptus* Dietz. Champion (1902:141) listed *Euclyptus* in synonymy with *Phyllotrox* Schönherr, a genus of Erirhininae. Warner (in press) verified this synonymy, and thus *Euclyptus* is removed from Endaeini. The other endaeine genera (*sensu* Kissinger) are treated herein as Tychiinae (*s. l.*). We recognize 4 tribes of Tychiinae: Tychiini, Lignyodini, Endaeini, and Elleschini; the latter 3 tribes contain the remaining genera of Kissinger's Endaeini. We review relationships among these tribes, relationships among genera of Lignyodini, and, in less detail, relationships among genera assigned to Endaeini and Elleschini. In addition, we present some new generic synonymy and new species combinations in Lignyodini, along with descriptions of a new genus and species in that tribe.

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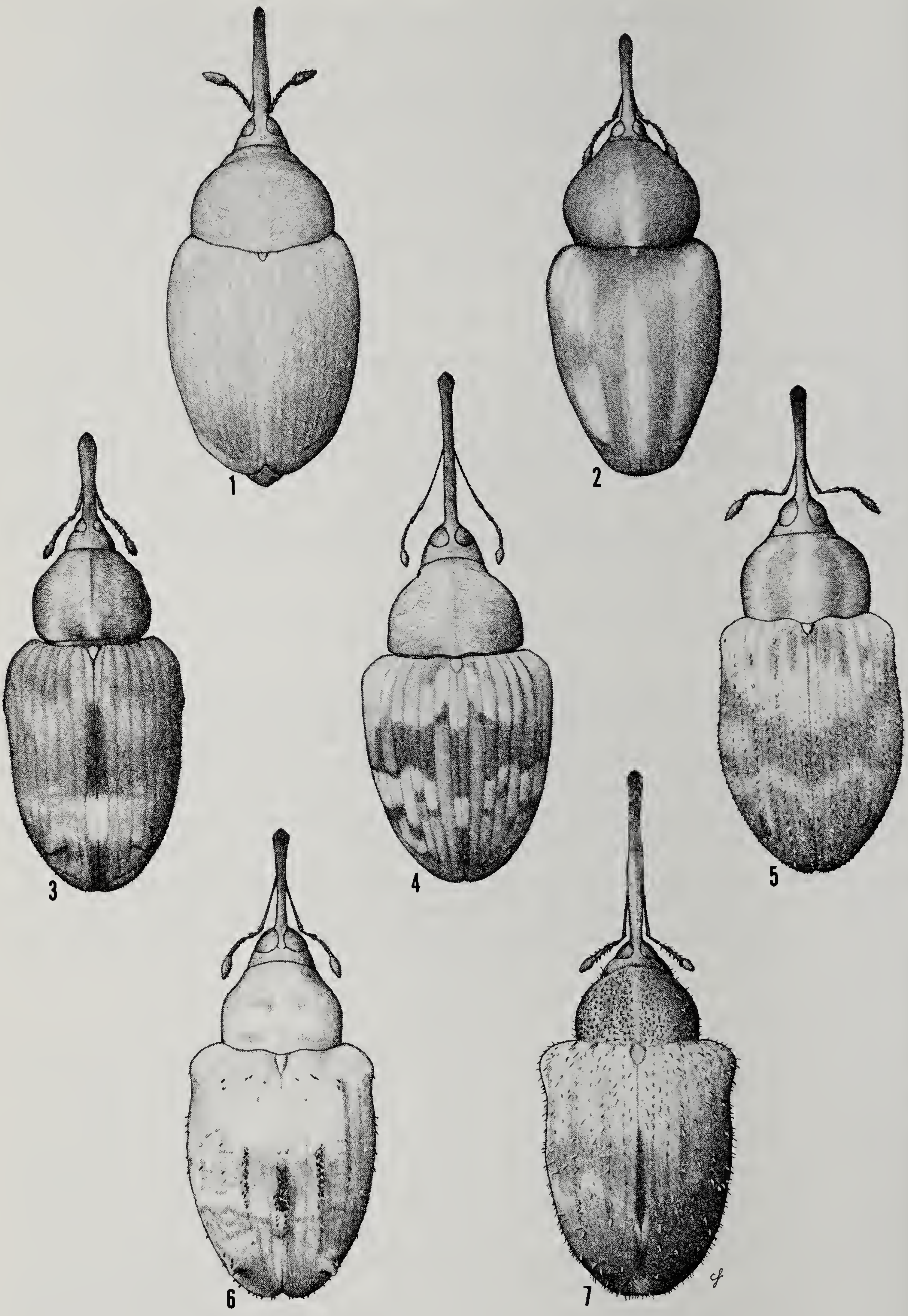


Figs. 1-7, dorsal view, female: 1) *Sibinia viscariae*; 2) *Tychius quinquepunctatus*; 3) *Plocetes ulmi*; 4) *Chionanthobius schwarzi*; 5) *Lignyodes bischoffi*; 6) *Neotylopterus pallidus*; 7) *Rosella sickingiae*.

Specimens studied for this paper are in the USNM; Costa Rican material of the new species was provided by D. H. Janzen, University of Michigan. Illustrations were prepared by I. C. Feller. Partial funding was from Janzen's NSF grants GB 35032X and BMS 75-14268. Some host information was obtained by Clark on a trip funded in part by the American Philosophical Society, Penrose Fund. We thank H. P. Stockwell for assistance in collecting in Panama, and Tom Croat for identifying weevil host plants collected there.

NEW SYNONYMY

In 1973 L. Dieckmann sent a series of *Lignyodes slovacicus* Dieckmann from Czechoslovakia to Warner who recognized the species as the North American *Thysanocnemis bischoffi* Blatchley, apparently introduced into Europe; *L. slovacicus* Dieckmann 1970:97-100 is accordingly placed in synonymy with *T. bischoffi* Blatchley 1916:240-241, **new synonymy.**

This synonymy brings into question the status of *Lignyodes* Dejean and *Thysanocnemis* LeConte as valid genera. Dieckmann (*in litt.*) stated that after examination of specimens of *T. fraxini* LeConte (type-species of *Thysanocnemis*) he would not hesitate to place the species in *Lignyodes.* Comparison of specimens of the type-species of *Lignyodes, L. enucleator* (Panzer), with *T. fraxini* leaves no doubt that they are congeneric; *Thysanocnemis* LeConte 1876:214 is therefore placed in synonymy with *Lignyodes* Dejean 1835:278, **new synonymy.**

Workers, including Dieckmann (1970), have generally cited Schönherr as author of *Lignyodes,* but the name should be attributed to Dejean. Nomenclature is as follows:

Lignyodes Schönherr 1833:19. A *nomen nudum* because neither description nor definition was given and because the only included species, *Elleschus bicolor* (Duftschmid), is itself a *nomen nudum* (Sherborn 1922:717).

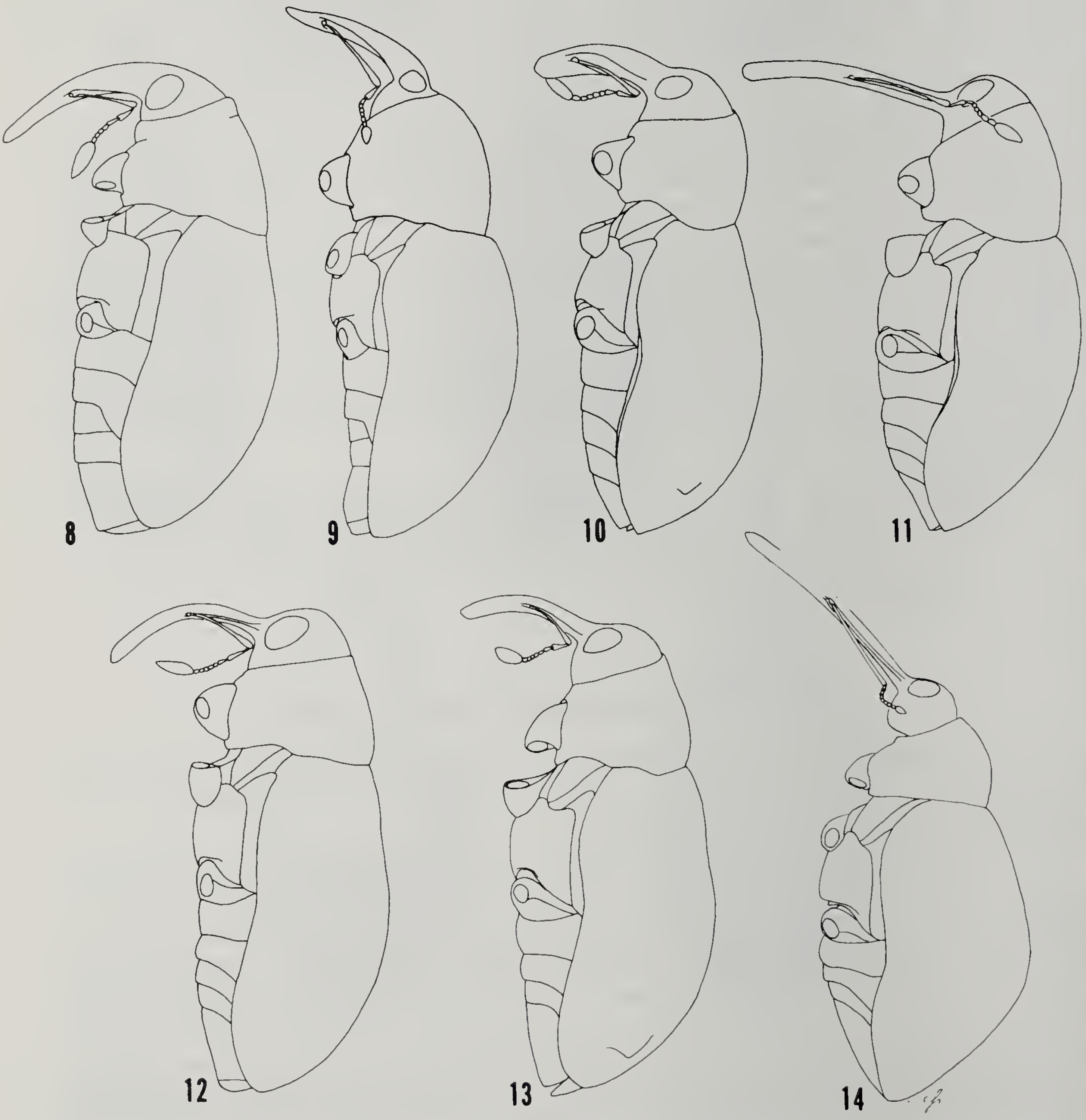
Lignyodes Dejean 1835:278. Type-species, *Curculio enucleator* Panzer, by monotypy. Art. 16(a) (v).

GENERIC AND SUPRAGENERIC RELATIONSHIPS

From examination of characteristics of representatives of North American genera assigned by Kissinger (1964) to Endaeini and Tychiinae (*s. str.*), we observe the following relationships:

A. Tychiinae *s. str.* members (figs. 1, 2, 8, 9, 15, 37) share the following apparently apomorphic (derived) character states, indicating that the included taxa form a monophyletic group: (**1**), sides of abdominal sternum 2 strongly angled posteriorly, covering sides of sternum 3 completely and sternum 4 in part, suture between sterna 3 and 4 nearly straight (fig. 22); and (**2**), spiculum gastrale Y-shaped, spiculum rod short with its apex not reaching apex of tegminal strut (figs. 42-43, *Tychius* and related genera) or spiculum gastrale composed of 3 plates and spiculum rod absent (figs. 44-45, *Sibinia* and related genera). These characteristics are diagnostic of the tribe Tychiini, as treated herein; distribution, fig. 51.

B. The genera *Lignyodes, Neotylopterus, Chionanthobius, Plocetes,* and *Hamaba* share the following apparently apomorphic character states with *Rosella,* new genus, indicating that they together form a monophyletic group: (**3**), eyes large, close together, more or less directed forward (figs. 3-7); (**4**), origin of rostrum from frons abrupt in most forms (figs. 10-14); (**5**), scrobe parallel with rostrum, reaching eye, not directed ventrad (figs. 17-21) except in *Plocetes* (fig. 16); (**6**), elytra with basal fascia of pale scales, broad median transverse band of dark scales, and narrower band of light scales posterior to dark band (figs. 4, 6, 7), pattern modified but similar in *Plocetes* (fig. 3), *Hamaba,* and most *Lignyodes* (fig. 5); (**7**), sutural intervals with black, usually erect scales (recumbent in *Chionanthobius,* absent in *Hamaba* and most *Lignyodes*); and (**8**), pygidium of male large, broadly convex (figs. 35-36), with large lateral swellings in *Rosella* and smaller swellings in *Neotylopterus.* These characteristics are diagnostic of the tribe Lignyodini, as treated herein; distribution, fig. 52.



Figs. 8-14, lateral view female: 8) *Sibinia viscariae*; 9) *Tychius quinquepunctatus*; 10) *Plocetes ulmi*; 11) *Chionanthobius schwarzi*; 12) *Lignyodes bischoffi*; 13) *Neotylopterus pallidus*; 14) *Rosella sickingiae.*

C. Tychiini and Lignyodini members share the following apparently apomorphic character states, indicating a sister group relationship: (**9**), sides of abdominal sternum 2 broadly curved (Lignyodini) or angled (Tychiini) posteriorly (figs. 22-27) (in Lignyodini the sides of sternum 3 are also curved posteriorly so the sides of sternum 2 do not cover them, but the structure of sternum 2 in Lignyodini is quite similar to that in Tychiini); (**10**), tegmen Y-shaped, without dorsal sclerotized components [Morimoto (1962a) stated that the cap-piece of the tegmen is vestigial or absent in several different Curculionidae without stating which ones, and he indicated a parallel development in Platypodidae. Bruhn (1947) noted a Y-shaped tegmen in some members of the subfamilies Hyperinae, Cryptorhynchinae, Ceutorhynchinae, and Anthonominae, but this condition does not characterize all members of these groups (cf. Burke 1959)]; (**11**), median struts freely articulated with base of median lobe (figs. 40-45) [Morimoto (1962a) stated that the mode of attachment of median struts in Curculionidae is variable, without specifying how or in which groups. Bruhn (1947) noted that some members of the subfamilies Hyperinae and Ceutorhynchinae also have freely articulated median struts and that the struts are "lightly attached" in *Anthonomus eugenii* Cano, Anthonominae. In *Rosella* the struts are connected to the median lobe but appear to be free because of lack of sclerotization at the points of attachment]; (**12**), tarsal claws subparallel at base, gradually divergent, basal processes elongate, slender [the tarsal structure of Lignyodini (fig. 32) is more or less intermediate between that of Tychiini (fig. 33) and that of *Ochyromera* (fig. 31) and *Proctorus* (fig. 30) which have widely divergent claws, each with a large, broad, flat basal process].

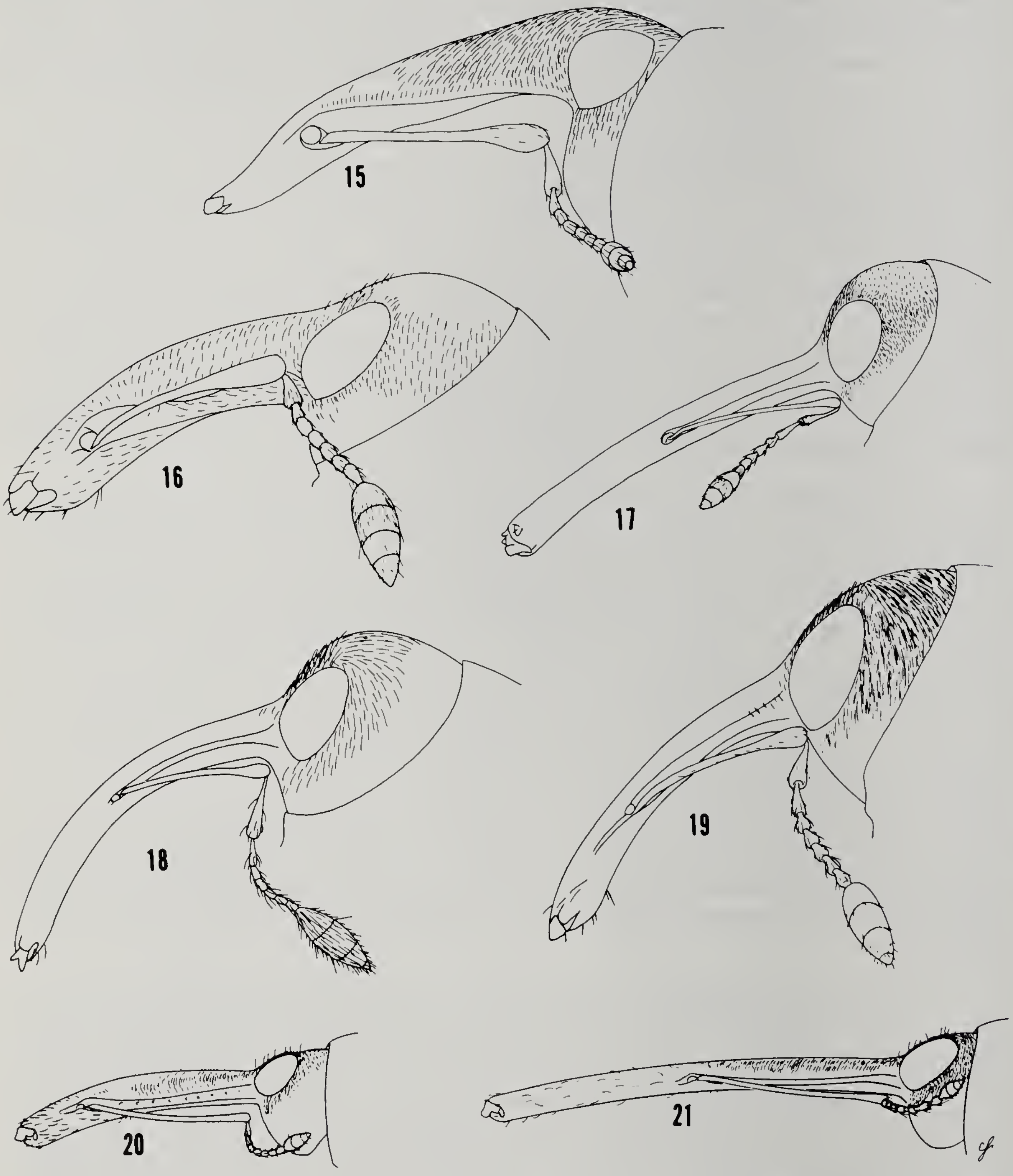
D. The genus *Ochyromera* shares the following apparently apomorphic character states with Tychiini and Lignyodini, indicating a sister group relationship: (**13**), male pygidium exposed beyond elytral apices (fig. 34-37); (**14**), tegmen with complete dorsal sclerotized ring but lacking additional dorsal sclerotized components (this possibly represents an intermediate stage in reduction toward complete loss of dorsal sclerotized components in Lignyodini and Tychiini, but see 10 above; we examined only *O. ligustri* Warner); (**15**), elytra with prominent posterior tubercles (reduced in *Lignyodes, Hamaba,* and Tychiini). In addition, the hosts of *Ochyromera ligustri (Ligustrum japonicum* Thunb., *L. lucidum* Ait., *L. amurense* Carr., and *Syringa* spp.) belong to the plant family Oleaceae, as do hosts of most Lignyodini. We assign *Ochyromera* to the tribe Endaeini, following Schenkling and Marshall (1936: 7), Voss (1958), and Morimoto (1962b). According to Morimoto (1962b) some Endaeini do not have the pygidium exposed.

E. The genera *Elleschus* and *Proctorus* share the following apparently apomorphic character states with Endaeini, Lignyodini, and Tychiini, indicating a possible sister group relationship: (**16**), sides of abdominal sterna curved posteriorly, to nearly the same degree in these genera (fig. 29) and in Endaeini (fig. 28) but less so than in Lignyodini (figs. 23-27); (**17**), scales on pronotum with apices directed toward midline. Here, we follow Thomson (1859) and Morimoto (1962b) in assigning *Elleschus* to the tribe Elleschini. Relationships of *Elleschus* and *Proctorus* are discussed below.

These views on relationships are summarized in diagrammatic form as a reconstructed phylogeny (fig. 53).

CLASSIFICATION OF TYCHIINAE

The following classification is based on what we believe to be probable phylogenetic relationships of the included genera. We have examined representatives of all genera of the tribes Elleschini, Lignyodini, and Tychiini, but our concept of the tribe Endaeini is based solely on examination of *Ochyromera* spp., especially *O. ligustri,* and a few *Endaeus* spp. The other genera listed below for Endaeini are from Schenkling and Marshall (1936), Voss (1958), and Morimoto (1962b); Morimoto also recognized a tribe Deminaeini for the genus *Deminaea* Pascoe, but we have not examined rep-



Figs. 15-21, lateral view of head: 15) *Tychius quinquepunctatus,* female; 16) *Plocetes ulmi,* female; 17) *Chionanthobius schwarzi,* female; 18) *Lignyodes bischoffi,* female; 19) *Neotylopterus pallidus,* female; 20) *Rosella sickingiae,* male; 21) same, female.

resentatives of this genus. We are more confident of the existence of a sister group relationship between Lignyodini and Tychiini than of the nature of relationships of Elleschini and Endaeini. A more detailed review of the relationships of these taxa to other Curculionidae is needed. We feel, however, that the present arrangement represents the relationships of these taxa more accurately than does Kissinger's (1964) system.

Subfamily TYCHIINAE
- Tribe ELLESCHINI
  - Genus *Elleschus* Stephens
  - *Proctorus* LeConte
- Tribe ENDAEINI
  - Genus *Drepanoscelus* Marshall
  - *Endaenidus* Morimoto
  - *Endaeus* Schönherr
  - *Exochyromera* Voss
  - *Eusynnada* Heller
  - *Gryphorhynchus* Roelofs
  - *Heterendaeus* Morimoto
  - *Nesendaeus* Marshall
  - *Ochyromera* Pascoe
  - *Opeoscapha* Faust
  - *Omphasus* Pascoe
  - *Synnada* Heller
  - *Menecopes* Faust
  - *Neochyromera* Heller
  - *Odontobaris* Faust
  - *Sphinxioides* Voss and Chujo
  - ?*Sphinxus* Roelofs
  - *Zeione* Pascoe
  - *Jezene* Heller
- Tribe LIGNYODINI
  - Genus *Lignyodes* Dejean
  - *Chionanthobius* Pierce
  - *Hamaba* Casey
  - *Neotylopterus* Hustache
  - *Plocetes* LeConte
  - *Rosella,* new genus
- Tribe TYCHIINI
  - Genus *Apeltarius* Desbrochers
  - *Xenotychius* Reitter
  - *Tychius* Germar
  - *Sibinia* Germar
  - *Dichotychius* Bedel
  - *Mecynopyga* Pierce
  - *Itychus* Kissinger
  - *Paragoges* LeConte

THE GENERA OF LIGNYODINI

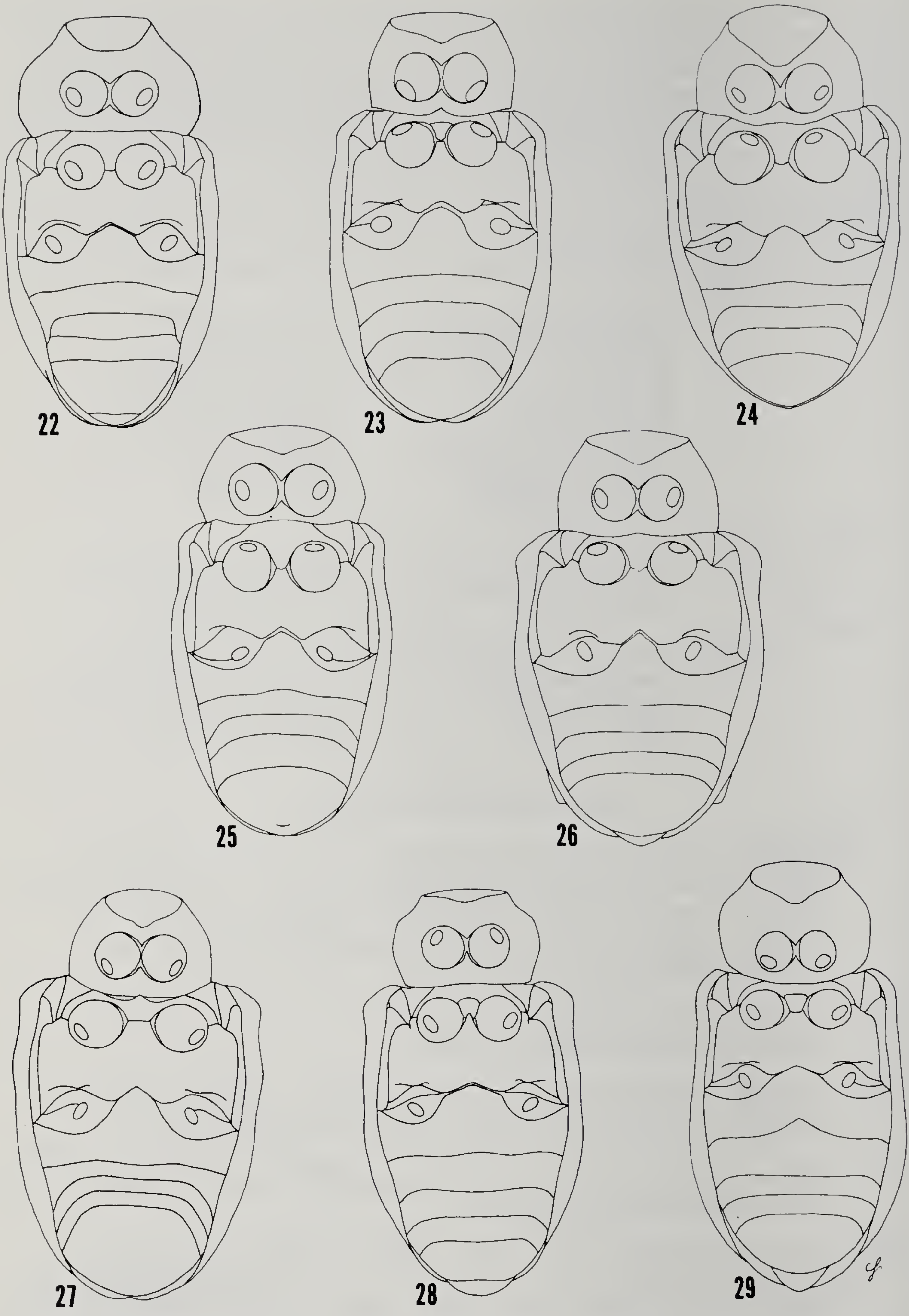
1. Rostrum short, coarsely sculptured, not strongly sexually dimorphic, scrobe strongly descending .... *Plocetes* LeConte
1′. Rostrum long, finely sculptured, strongly sexually dimorphic, scrobe longitudinal or if descending then at least nearly parallel to long axis of rostrum 2

2(1′). Subapical elytral tubercles prominent 3
2′. Subapical tubercles feeble or absent 5

3(2). Sternum 5 longer than sterna 2-4 combined; female antenna inserted at midrostrum; femur armed with minute tooth .... *Rosella,* new genus
3′. Sternum 5 shorter than sterna 2-4 combined; character combination otherwise not as above 4

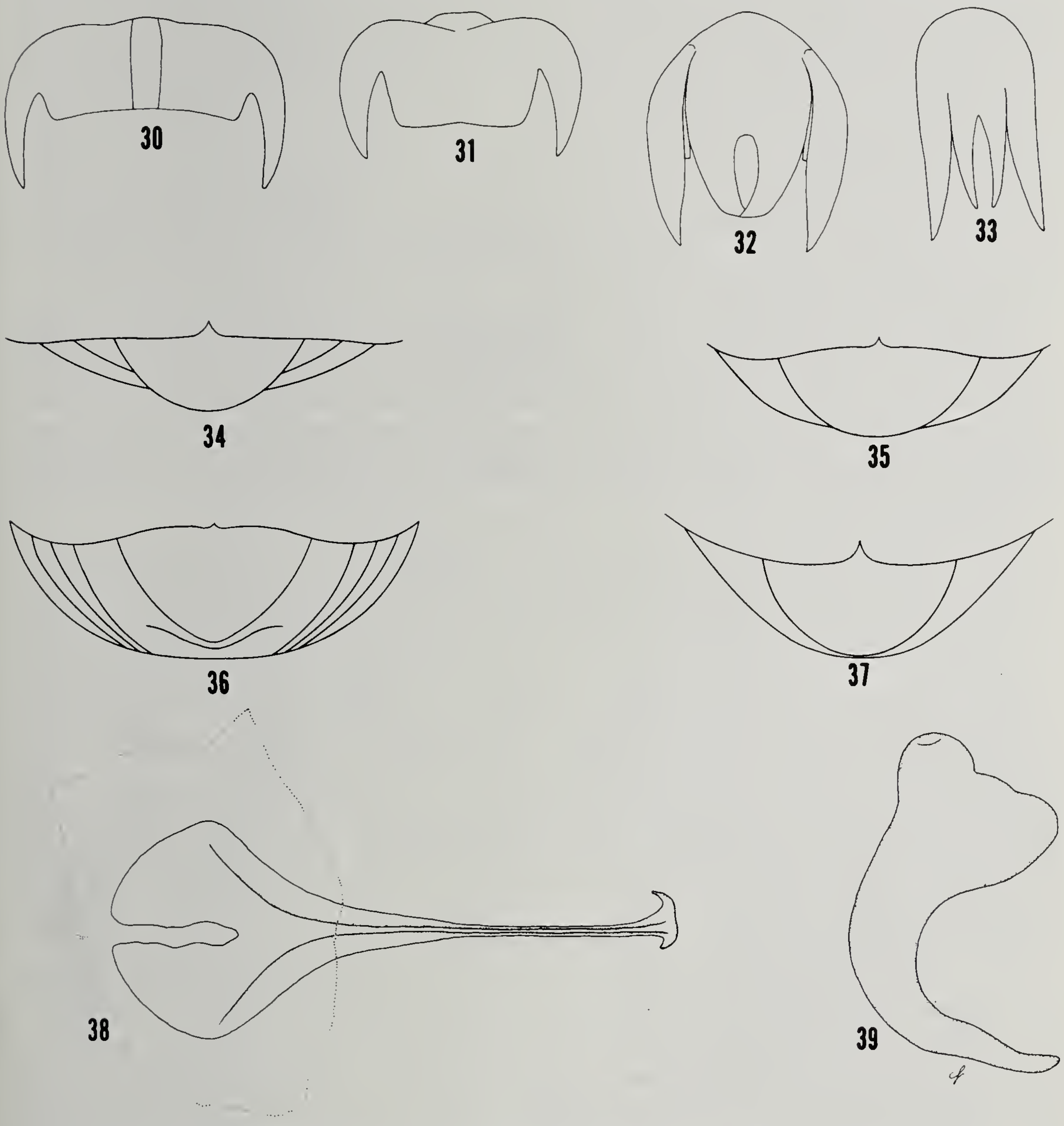
4(3′). Femur unarmed; elytra with erect as well as recumbent scales .... *Neotylopterus* LeConte
4′. Femur armed with minute tooth; scales on elytra uniformly recumbent .... *Chionanthobius* Pierce

5(2′). Small species, 1.44-1.59 mm. in length, Bahama Islands and Florida .... *Hamaba* Casey
5′. Larger species, North, Central, and South America and Eurasia .... *Lignyodes* Dejean



Figs. 22-29, ventral view, female: 22) *Tychius quinquepunctatus*; 23) *Plocetes ulmi*; 24) *Chionanthobius schwarzi*; 25) *Lignyodes bischoffi*; 26) *Neotylopterus pallidus*; 27) *Rosella sickingiae*; 28) *Ochyromera ligustri*; 29) *Proctorus armatus*.

Genus *Lignyodes* Dejean. Type-species, *L. enucleator* (Panzer). See figs. 5, 12, 25 for dorsal, lateral, and ventral views of female and fig. 18 for lateral view of rostrum of female of *L. bischoffi* (Blatchley). Characteristics are various, as noted in previous discussion; *Lignyodes* members variously have symmetric or asymmetric male genitalia, and the genus may therefore be paraphyletic. Distribution, fig. 52; 29 species are assigned to *Lignyodes* —4 from Eurasia (Dieckmann 1970), 8 from the United States, 1 from Mexico and Belize, 6 from Guatemala, 1 from Nicaragua, 4 from Panama, 2 from Venezuela, 2 from Peru, and 1 from Brazil (Klima 1934). Known hosts of North American and European species are members of *Fraxinus* (Oleaceae).



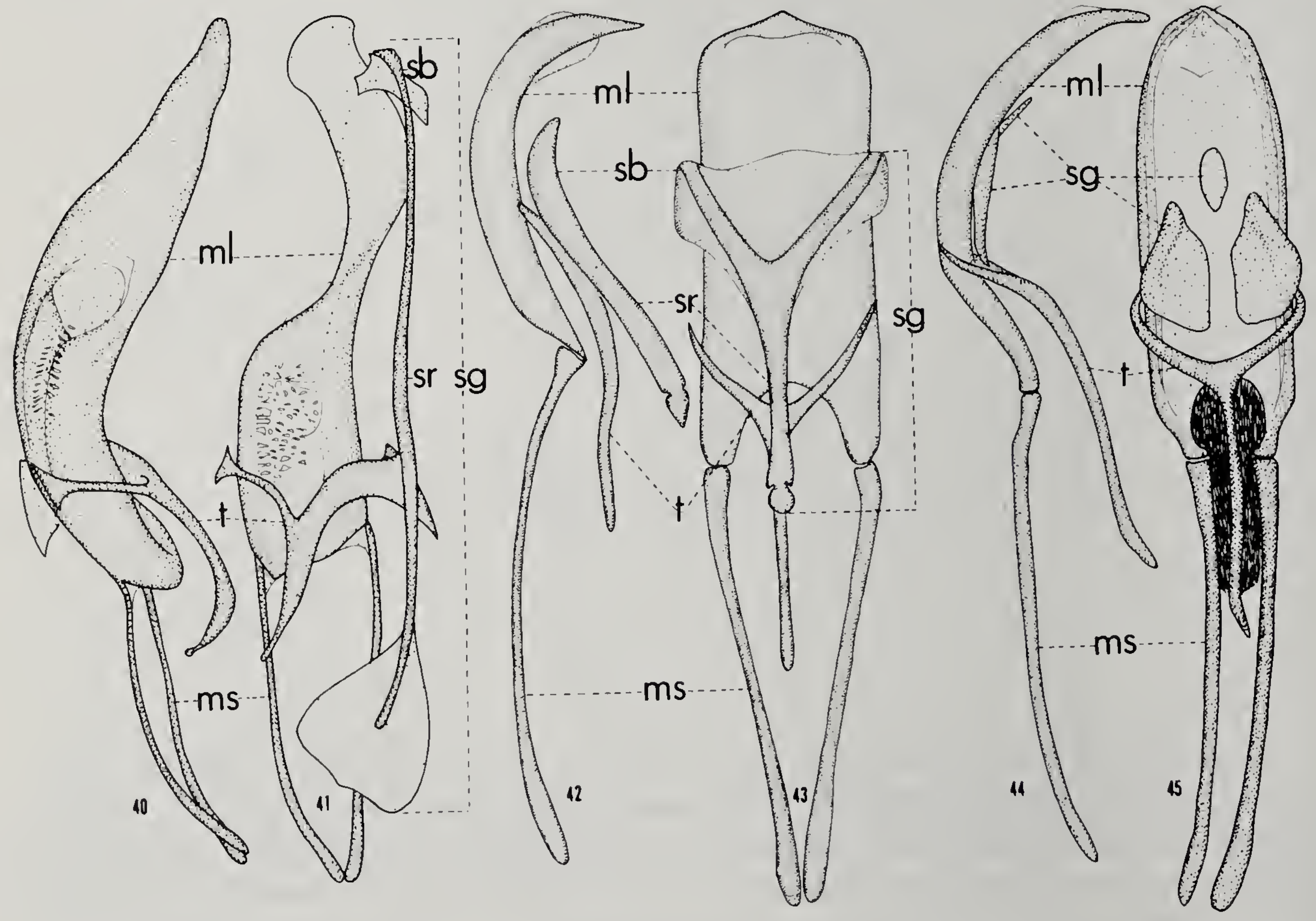
Figs. 30-33, tarsal claws: 30) *Proctorus armatus*; 31) *Ochyromera ligustri*; 32) *Lignyodes bischoffi*; 33) *Tychius quinquepunctatus*. Figs. 34-37, male pygidium: 34) *Ochyromera ligustri*; 35) *Lignyodes bischoffi*; 36) *Rosella sickingiae*; 37) *Tychius quinquepunctatus*. Figs. 38-39, *Rosella sickingiae* female: 38) spiculum ventrale; 39) spermatheca.

An unidentified Panamanian species was reared from seeds of *Macrocnemum glabrescens* (Benth.) Wedd. (Rubiaceae) collected on Barro Colorado Island, Canal Zone, by H. P. Stockwell. Clark collected adults of another unidentified species on *Rondeletia buddleioides* Benth. (Rubiaceae) at Cerro Campana, Panama. Hosts of other neotropical species are unknown.

Genus *Hamaba* Casey. Type-species, *H. bahamensis* Casey. We have not illustrated this genus here; the hind tibia lacks a spine, but *Hamaba* is not otherwise structurally different from *Lignyodes s. l.* Distribution, fig. 52; 2 included species, Bahama Islands and Florida. Host unknown.

Genus *Neotylopterus* Hustache. See figs. 6, 13, 26 for dorsal, lateral, and ventral views of female and fig. 19 for lateral view of female rostrum of *N. pallidus* (LeConte), the type-species. Characteristics are given in previous discussion and key. Distribution, fig. 52; previously assigned species are *N. pallidus, N. varius* (LeConte), and *N. baboquivariensis* Sleeper from the United States and *N. ligeri* (Hustache) from Bolivia. Two additional species, previously placed in *Thysanocnemis,* also have characteristics of *Neotylopterus*: *N. graphicus* (Casey 1892:425), **new combination,** and *N. yavapaiensis* (Sleeper 1954:120), **new combination;** Sleeper (1954) compared *N. yavapaiensis* with *N. graphicus* in his original diagnosis. Known hosts are various species of *Forestiera* (Oleaceae).

Genus *Chionanthobius* Pierce. Monobasic. See figs. 4, 11, 24 for dorsal, lateral, and ventral views of female and fig. 17 for lateral view of female rostrum of *C. schwarzi* Pierce. Characteristics are given in previous discussion and key. Distribution, fig. 52. *C. schwarzi* develops in seeds of *Chionanthus virginicus* L. in eastern North America; other species of *Chionanthus* (Oleaceae) occur in China.



Figs. 40-45, male genitalia, lateral and ventral: 40-41) *Rosella sickingiae*; 42-43) *Tychius quinquepunctatus*; 44-45) *Sibinia viscariae*.

Genus *Plocetes* LeConte. Monobasic. See figs. 3, 10, 23 for dorsal, lateral, and ventral views of female and fig. 16 for lateral view of female rostrum of *P. ulmi* LeConte. Characteristics are given in previous discussion and key. Distribution, fig. 52. Host unknown; records from *Ulmus* are unverified; *Cephalanthus* (Rubiaceae) is the suspected host (Blatchley 1916).

Rosella Whitehead, **new genus**

Type-species. R. sickingiae Whitehead, new species, by present designation and monotypy.

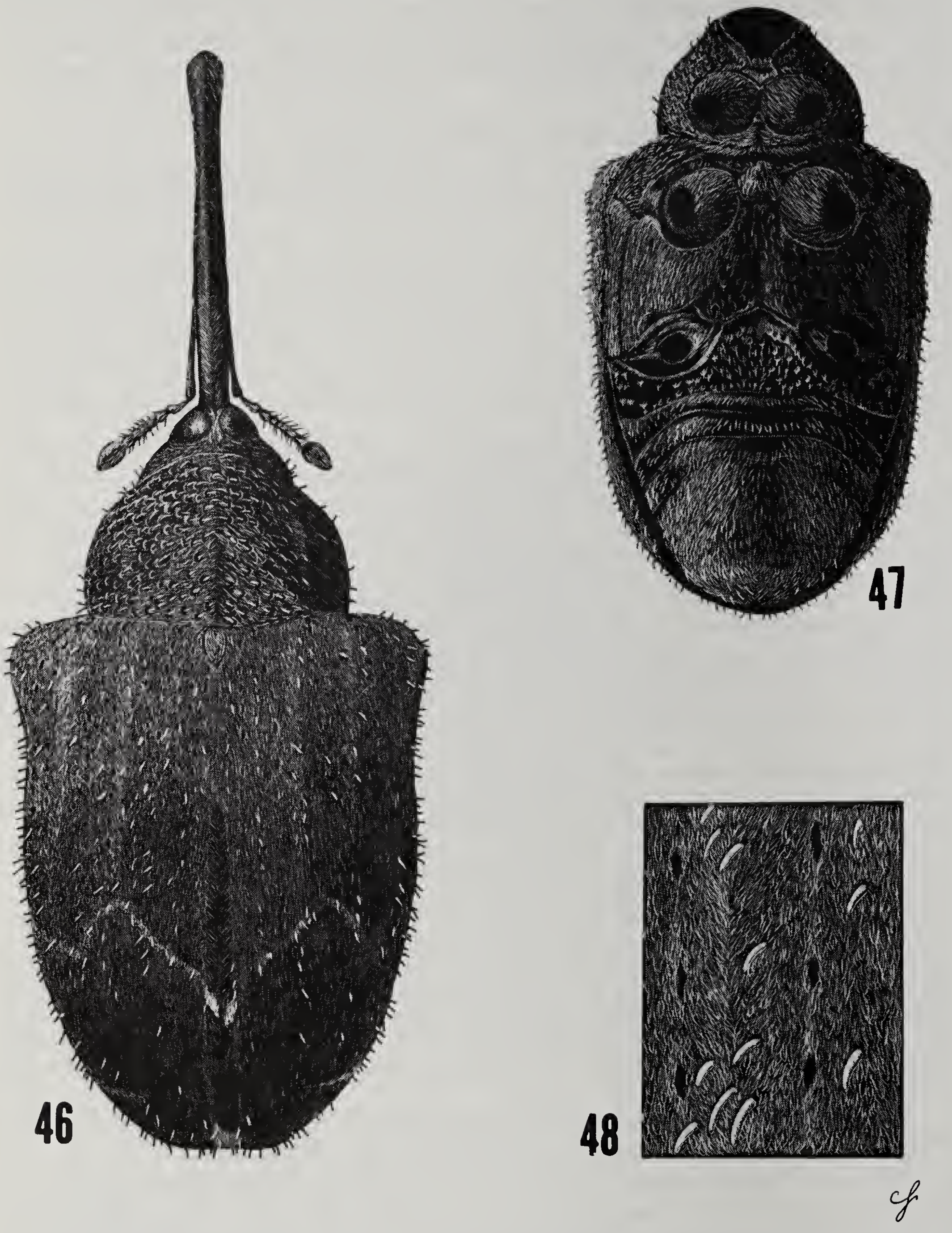
Diagnosis. Adults of the only known species of this genus are much larger than other known Lignyodini. A combination of abdominal features is diagnostic: sternum 5 long, transversely oval, longer than sterna 2-4 combined; sterna 2-4 equally long; and sterna 4-5 fused, suture 4 less distinct than sutures 1-3. Some *Lignyodes* have sternum 5 nearly as long, but with sterna 3 and 4 each much shorter than 2 and with suture 4 no less distinct than sutures 1-3.

Description. Tychiinae: Lignyodini. Large, robust; length from apex of pronotum to apex of elytra ca. 7.5-8.5 mm. *Rostrum*: long, slender, barely arched, convex ventrally at base; scrobe parallel to long axis of rostrum, extended nearly to anterior margin of eye; rostrum in female about 2.5 × length of pronotum, nearly uniformly cylindrical, dorsum nearly smooth, antennal insertion near midpoint; rostrum in male about 1.5 × length of pronotum, dorsoventrally expanded near antennal insertions, dorsum strongly bisulcate, antennal insertion near distal 1/3. *Antenna*: scape extended nearly to anterior margin of eye, as long as funicle and club combined; funicle 7-segmented, 2 1/2 times as long as club; club 3 times as long as wide. *Head*: eyes large, oblong dorsoventrally, separated by distance 0.1-0.2 times width of rostrum at antennal insertions. *Prothorax*: coarsely, deeply punctate; interspaces narrow; punctures near midline finer, sparser; midline with fine dorsal carina; procoxal cavities slightly nearer base than apex of prosternum; carinae extended from apical midpoint of each coxal cavity to apex, prosternum concave between; neither apical nor basal intercoxal processes prominent. *Elytron*: humerus and subapical tubercle prominent; sutural interval distinctly carinate in apical 2/3; interval 3 distinctly raised in basal 3/4, interval 5 in basal 2/3, interval 7 in basal 1/2, interval 9 from humerus to apex; strial punctures coarse, partially obscured by vestiture. *Meso- and Metathorax*: venter except for mesosternum coarsely punctate; mesosternum produced mesally as prominent tubercle, feebly punctate. *Legs*: femora feebly clavate, each armed with minute tooth, tooth obscured by vestiture; tibiae uncinate. *Abdomen*: sternum 5 longer than sterna 2-4 combined, sterna 2-4 each about equally long; suture 1 slightly curved backward at lateral 1/4, suture 2 strongly so, sutures 3-4 less strongly so than suture 2; suture 4 less distinct than sutures 1-3; pygidium in male vertical, exposed, with prominent lateral swellings, in female oblique, flat, nearly completely covered. *Median lobe*: asymmetric, twisted.

Distribution. Records of this genus are from southern Central America (Costa Rica) and northern South America (Guyana), fig. 52.

Natural history. Rosella is one of the few lignyodines known from fruits of Rubiaceae. Larvae develop in fruits of *Sickingia* Willd., bivalved globular pods with numerous winged seeds; they feed by grazing within the pod, each destroying numerous seeds; pupation occurs within the fruit. See Janzen and Wilson (1977) for a more extended discussion of natural history. Larvae of most other lignyodine genera, except for some Neotropical *Lignyodes,* develop internally in the samaras or berries of various Oleaceae, emerge from the fruit, and pupate in the ground.

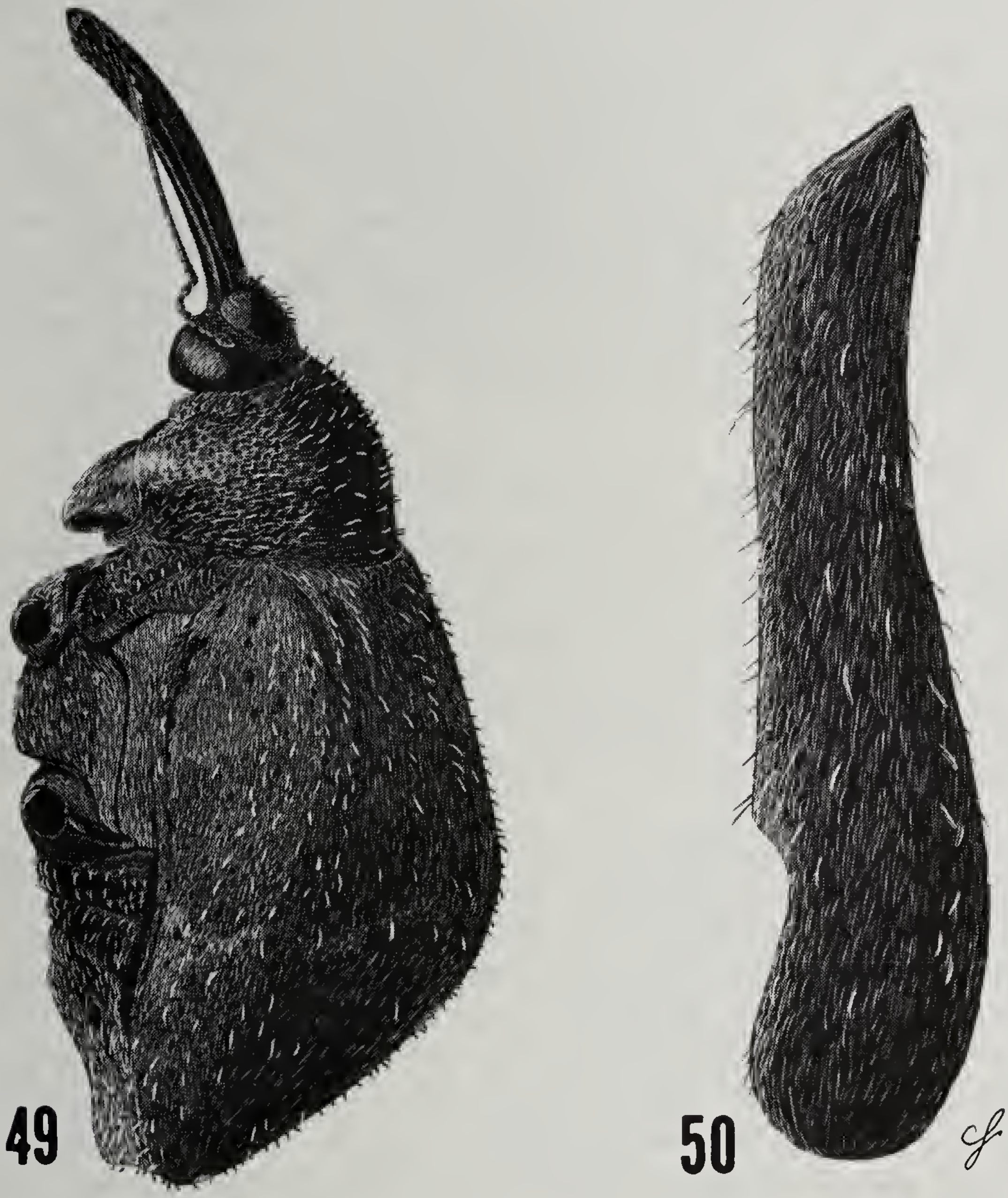
The generic name *Sickingia* has at various times been placed in synonymy with *Simira* Aubl., recently so by Steyermark (1972), but this synonymy does not yet seem to have acquired general acceptance.



Figs. 46-48, *Rosella sickingiae*: 46) habitus, female; 47) venter, male; 48) detail near base of left elytron.

Relationships. The taxon *Lignyodes* probably is paraphyletic, in that the median lobe of the male genitalia is variously symmetric or asymmetric. If the asymmetric median lobe is synapomorphous within Lignyodini, then *Rosella* is part of a monophyletic assemblage including *Neotylopterus, Plocetes,* and some *Lignyodes,* but precise relationships are not clear. The association of *Rosella,* some *Lignyodes,* and possibly *Plocetes* with members of the plant family Rubiaceae probably has phylogenetic significance, but whether the Rubiaceae association is apotypic, plesiotypic, or convergent is not clear.

Etymological note. This distinctive weevil is named for Rose Ella Warner, in recognition of her contributions to knowledge about weevils and for her advice and encouragement. The name *Rosella* is feminine in gender.



Figs. 49-50, *Rosella sickingiae*: 49) lateral view, male; 50) right front femur.

Rosella sickingiae Whitehead, **new species**

Type-material. Holotype: male labelled "D. H. Janzen Ex Sickingia maxonii 3 Sept. 1970" and "1 mi. N. Puerto Viejo, Sarapiqui Dist., Heredia Prov. COSTA RICA". Type-depository: U. S. National Museum of Natural History, Washington, D. C.; USNM type #73808. *Allotype*: female, same label data as for holotype. *Paratypes*: 16, same date and place as holotype; 21, same place but 17 Feb. 1971; and 1, labelled "Guyane". Paratypes will be distributed to various collections.

Diagnosis. R. sickingiae is the only known species of the genus. The following description, therefore, is an extension of that of the genus, with illustrations of habitus and structural details and with description of color and vestiture.

Description. Length, pronotum + elytron, 7.5-8.3 mm. See illustrations of habitus (figs. 46, 48, 49), head (figs. 20-21), venter (fig. 47), leg (fig. 50), pygidium (fig. 36), spermatheca (fig. 39), spiculum ventrale (fig. 38), and male genitalia (fig. 40-41). Vestiture of generally fine, hairlike, recumbent, pale brown scales; erect, stout, mixed white and brown scales interspersed over much of the body surface, notably along crests of elytral intervals. Strial scales fine, white, appressed. Vestiture on most of body dense, but sparse on apical half of rostrum, on most of prothorax except along midline and expanded basal area, on sterna 1-2, and on middle of sternum 3. Elytron pale brown in basal 1/3, in irregular transverse band near middle, and along sutural interval externally in apical 1/3; dark brown in humeral region, in wide band in front of median pale band, and in apical 1/2; sutural interval in apical 2/3 with broken, velvet like vitta of suberect, nearly black scales. Abdomen with fine hairlike scales on middle of sternum 1, gradually more dense on sterna 2-3, dense on sterna 4-5; suture 4 partially obscured.

Notes on Endaeine and Elleschine Genera

As stated above, our concept of the tribe Endaeini is based on examination of *Ochyromera ligustri* Warner, which was introduced into the eastern United States from the Oriental Region (Warner 1961), and a few other *Ochyromera* and *Endaeus* spp. in the USNM. The genera occur throughout the Oriental and Ethiopian Regions. As noted above, hosts of *Ochyromera ligustri* are all members of the Oleaceae; we have no host data for other endaeines.

We include 2 genera, *Elleschus* Stephens and *Proctorus* LeConte, in the tribe Elleschini. Until Kissinger (1964) placed these genera in Endaeini (Anthonominae), *Elleschus* was traditionally considered a tychiine genus (Lacordaire 1863, Casey 1892, 1910, Blatchley and Leng 1916, Leng 1920, Klima 1934), and North American workers followed LeConte (1876) in assigning *Proctorus* to Tychiinae. *Elleschus* contains some 15 species in North America, the Palaearctic Region, and Australia (Klima 1934). *Proctorus,* with 2 species, is limited to North America. Nearctic *Elleschus* and *Proctorus* are associated with willows (*Salix* spp.), Salicaceae. They bear a general resemblance to each other but their relationships to each other and to other Tychiinae are in question. They differ from the other tychiine genera in having the pygidium completely concealed and in having distinct paired dorsal lobes on the tegmen. These are probably plesiomorphic (primitive) conditions shared with Anthonominae (with which *Elleschus* and *Proctorus* have been associated), Erirhininae (some of which they resemble), and various other curculionid subfamilies.

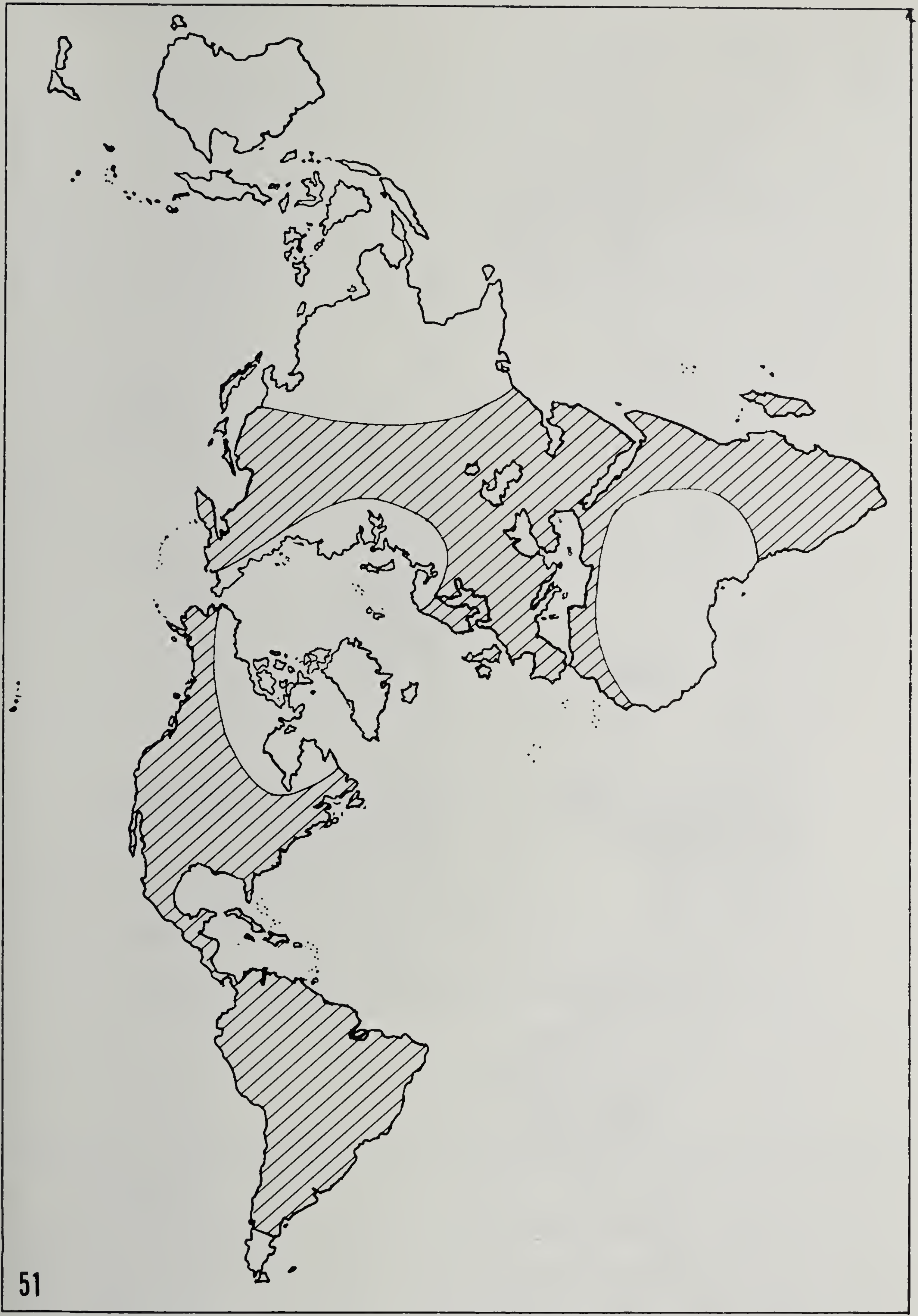
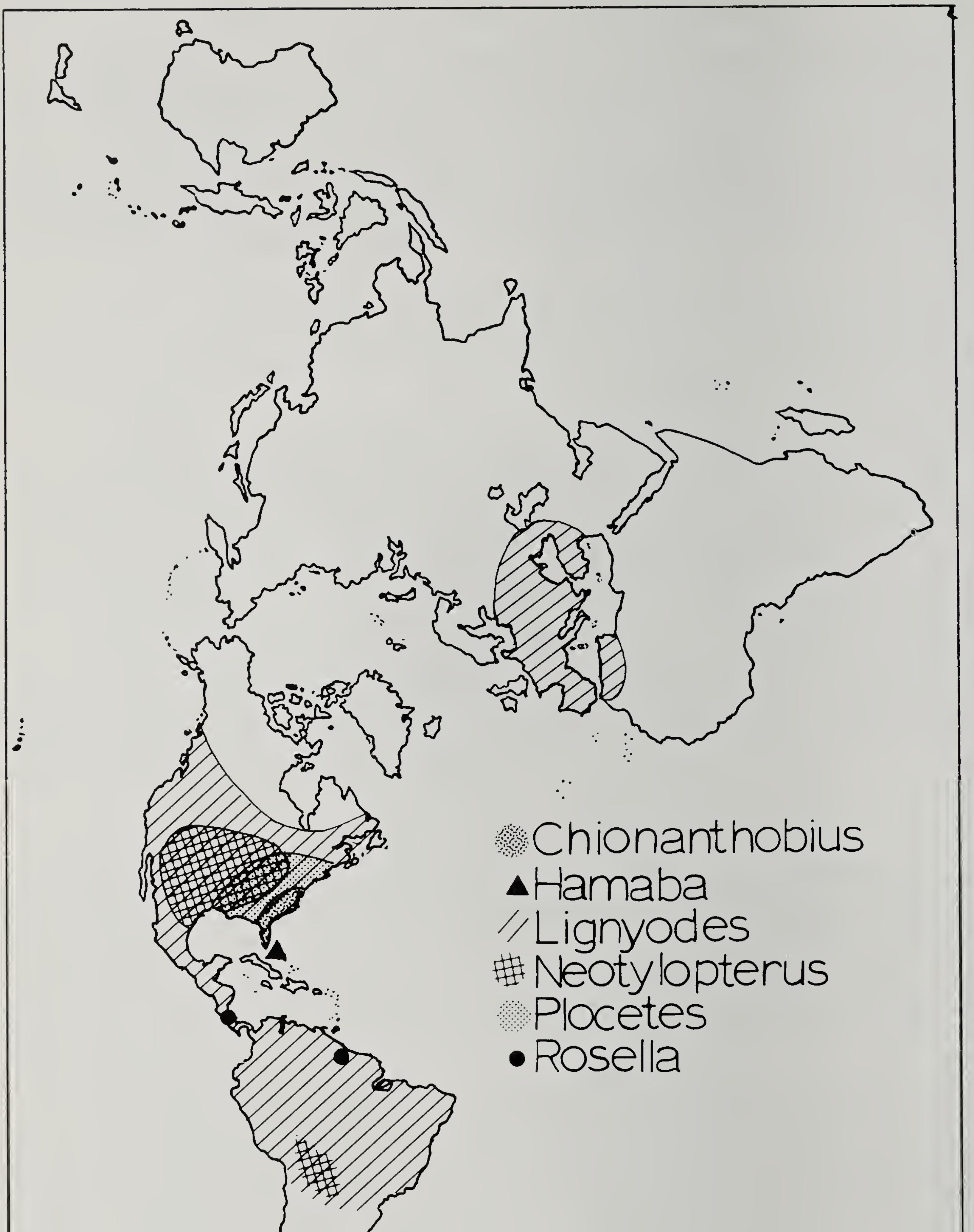
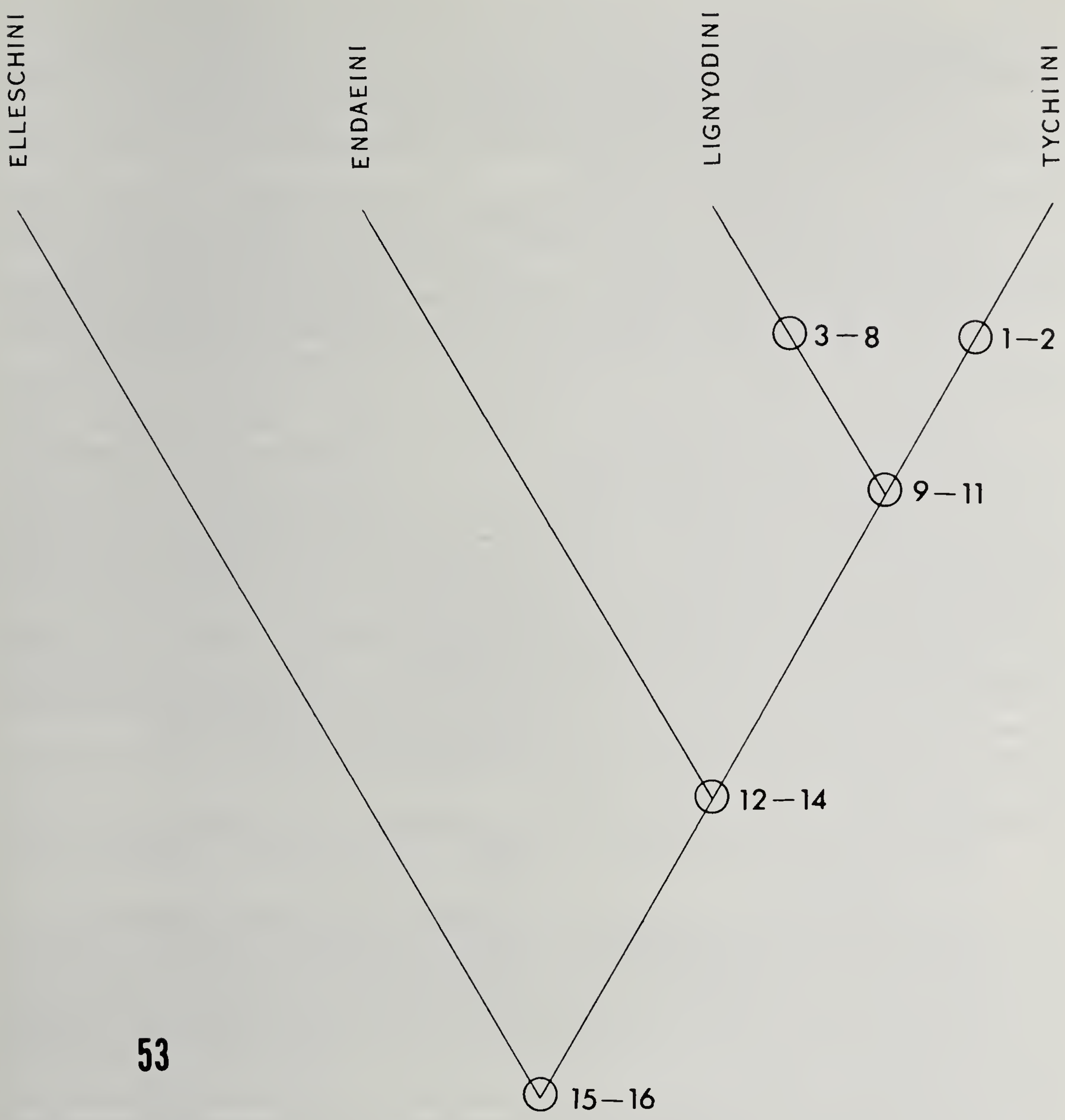


Fig. 51, composite geographic distribution of Tychiini.



52

Fig. 52, geographic distributions of genera of Lignyodini.



53

Fig. 53, reconstructed phylogeny of tribes of Tychiinae.

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NATURAL HISTORY OF SEED PREDATION BY *ROSELLA SICKINGIAE* WHITEHEAD (CURCULIONIDAE) ON *SICKINGIA MAXONII* (RUBIACEAE) IN COSTA RICAN RAINFOREST

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Abstract

Natural histories of the neotropical rainforest tree *Sickingia maxonii* and its weevil seed predator *Rosella sickingiae* are briefly discussed. Attack rate is highest on the first fruits produced, gradually declining for fruits becoming susceptible later in the season. Up to 6 weevil larvae may attack each fruit; a single weevil per fruit destroys about 25% of the seeds, whereas 4 or more per fruit destroy 100%. However, under the normal, poorly insolated, humid forest conditions, fruits with exit holes are invaded by moth larvae, fungi, rain water, and various fruit scavengers, resulting in loss of remaining viable seeds.

In the rainforest in the vicinity of the town of Puerto Viejo, Sarapiquí District, Heredia Province, Costa Rica, *Sickingia maxonii* (Rubiaceae) is a moderately abundant subcanopy tree. Adult trees are found most frequently on stable and well-forested banks of small streams and rivers. The seeds in *S. maxonii* fruits are eaten by the larvae of the large weevil *Rosella sickingiae* Whitehead. We briefly discuss the natural histories of the tree and of the weevil as background for describing the interaction between them.

SICKINGIA MAXONII

In an intact forest, the crown of an adult *S. maxonii* (guaytil colorado) is normally under moderately intense shade from canopy-member crowns directly above. When a break in the overstory canopy occurs such that a small fraction of the *S. maxonii* crown is directly insolated, that crown segment bears a moderate number of yellow flowers sometime between July and September. These flowers produce a small number of large fruits which require 8 months or more to mature. Mature fruits may persist on the tree for several more months. The winged seeds inside are separate and somewhat dry. Eventually the husk dries and splits, and the heavy seeds fall to the ground. Laboratory feeding tests with *Heteromys desmarestianus,* a common rainforest rodent, indicate the seeds are highly desirable as food items (T. H. Fleming, personal communication).

The spheroidal, smooth gray-green fruits of *S. maxonii* are 5-7 cm in diameter with a 4-6 mm thick rind or husk. The seeds are layered neatly inside. Most seeds are viable (filled) before the weevil larva gets to them. A sample of 103 fruits from one tree contained an average of 27.08 seeds (S.D. = 7.64); if this value varies significantly among individual trees, the variation is too slight to be conspicuous in our examination of fruit collections. The low percentage of aborted seeds in the fruits suggests that the tree either can self pollinate (unlikely), that the pollen arriving at a flower is sufficient to fertilize all of its ovules, and/or the plant aborts all flowers except those with a full complement of fertilized ovules. Perhaps even some fully-fertilized fruits are aborted in order to match the fruit crop size to the energy reserves then available.

The adult *S. maxonii* in the forest have extremely small fruit crops. For example, in September-October 1970, we surveyed 20 adult trees in the forest at Finca La Selva near Puerto Viejo, and the numbers of mature and nearly mature fruits were (number of fruits in parenthesis): 10(0), 4(1), 2(2), 1(3), 1(15), and 2(20). It is possible that this was a "low" seeding year for *S. maxonii,* but crops in other years appear to be of the same small size. However, 3 trees (not included above) that were fully exposed to the sun bore several thousand fruits in the same sample period. It appears that the usual fruit crop size for *S. maxonii* is less than 20, usually borne on 1 or 2 insolated branches.

That the size of *S. maxonii* fruit crops is determined by the fairly immediate amount of insolation received by the individual trees is suggested by their behavior when shading trees are removed. For example, in the arboretum at Finca La Selva, there are 2 large adult *S. maxonii* whose crowns were partly freed of vertical and lateral shading by the removal of neighboring trees. In 1970-71, at the time of clearing, these trees were producing the usual small fruit crops. At present (1974, 1975, 1976) however, these lightly insolated trees are producing crops of as many as 500 fruits.

The most extreme example was provided by 4 adult *S. maxonii* growing in the forest along the west bank of the Rio Sarapiquí. Sometime between 1966 and 1970, all the forest to the southwest of these trees was cut and converted to pasture, thereby exposing the top and southwest half of their crowns to direct insolation. The eastern sides of the crowns were heavily shaded by the dense taller crowns of evergreen rainforest tree species. Tree number 128 had an estimated 1,625 fruits on its insolated side and 225 on its shaded side. Tree number 257 had an estimated 1,050 fruits on its insolated side and none on its shaded side.

The details of sexual phenology have never been worked out for *S. maxonii.* However, censuses of tree numbers 128 and 257 on 3 September 1970 revealed that all fruits were old enough to have full-sized milk seeds or mature seeds, and the oldest fruits had just begun to split (less than 1% had actually dehisced). We estimated that it would have taken at least 3 months before the least mature fruits would have begun to dehisce on these fully insolated trees. It is probable that the analogous period would be even longer in the heavily shaded forest sub-canopy habitat occupied by the crowns of most *S. maxonii.*

ROSELLA SICKINGIAE

Adult *R. sickingiae* arrive at the fruits when they are full-sized but contain milk seeds not yet full-sized. Adults (sex unknown) puncture the fruit wall with their mandibles to a depth of 1-2 mm, apparently feeding on this tissue. An egg is laid in one of these apparent feeding pits, and the newly hatched larva mines down the core of the fruit and then out into the full-sized but not yet mature seeds. As many as 5 or 6 larvae may mine into one fruit, but each appears to represent a separate oviposition. As the larva grows, it mines from seed to adjacent seed, eating most or all of the content of each seed in the process. The larva pupates in the fruit, and the newly emerged adult chews a circular exit hole through the fruit wall and departs. Adults fly readily upon emergence from the fruit. Some adults fail to burrow out and die in the fruits.

Based on the stages of larvae in the fruit crop of trees number 128 and 257, we hypothesize that by the time the first adults emerge from a fruit crop, the most immature fruits are usually too old for further oviposition, and thus there is only one generation of weevils per fruit crop.

We also hypothesize that these beetles have no other hosts until the following year's *S. maxonii* fruit crop appears at the appropriate state of ripeness. To date, fruits or seeds from no other plant species in this area have produced *R. sickingiae,* nor has damage resembling that made by this weevil been observed. The newly emerged adults can live at least 4 months in dry clean bottles but die in the fifth month (n = 16). Perhaps they feed on vegetative parts of *S. maxonii,* as they do on the green fruits, until the next crop appears.

INTERACTION OF *S. maxonii* AND *R. sickingiae*

A more detailed analysis of the pattern of seed predation by *R. sickingiae* in the crops of the 4 heavily insolated trees (128, 257, 258, 259) near Puerto Viejo summarizes the overall interaction (Table 1).

At the time of fruit collection, the fruits in tree 128 could be categorized as oldest (dry and ready to dehisce), middle-aged (mature but still soft with moist "pulp" around the seed), and young (green full-sized fruits with milk seeds nearly all full-sized). About 52% of the old and middle-aged fruits had been attacked by *R. sickingiae,* while only 28% of the young fruits had been attacked. None of the fruits had young larvae in them, implying that entry by weevils had been terminated for some time. We interpret these observations to mean that the attack rate is highest on the first fruits produced in the crop and gradually declines for fruits that reach a susceptible stage progressively later in the season. The decline in attack rate could be due to exhaustion of the oviposition ability of the weevils, removal of the weevils by mortality, or both, as the season progresses.

This hypothesis is indirectly supported by the number of weevils per fruit in this crop. We found a maximum of 6 larvae in a fruit. For any number of larvae greater than 3, however, virtually all seeds were destroyed and we assume that the larvae exhausted the food. We further suspect that to avoid predation on her larvae by other larvae, a female weevil lays only one egg per fruit and prefers fruit lacking larvae. However, when the fruits first become susceptible to oviposition, there should be a maximum number of weevils and a minimum number of fruits. This should lead to multiple ovipositions because of repeated encountering of fruits by the same and different weevils, and the shortage of vacant fruits. As can be seen from Table 1, the oldest fruits in tree 128 have the greatest number of weevils per attacked fruit (1.77), the middle-aged fruits an intermediate number (1.36), and the youngest the least (1.19).

The 4 trees described in Table 1 were all within 40 m of each other and had nearly contiguous crowns. Thus the pattern of weevil attacks may be viewed as a product of differential ripening in different parts of one huge crown. With this interpretation in mind, the synchronized crops of trees 128, 257, and 258 would represent only one crop and thus the similarity of percentage attacked is not unexpected. However, tree 259 may be viewed as a large branch within this crown with fruit development at least 2 months behind the others. It is paradoxical that its young to early middle-aged fruit have a much higher percent attack and a higher number of weevils per fruit than the fruits of the same age on tree 128. We interpret this to mean that as the crops on trees 128, 257, and 258 passed through their susceptible stages and susceptible fruits became rare, the few remaining weevils from each of trees 128, 257, and 258 could add up to a large number for a single tree. If this event actually occurred, it could have resulted in even a more precipitous decline in seed attack for trees 128, 257, and 258 than would have occurred had 259 not been present with its large number of younger fruits late in the season.

TABLE 1. Distribution of weevils among fruits of *Sickingia maxonii* in the Puerto Viejo region.

Tree (Date)	n	% of fruits with 1 or more weevils	average number of larvae per attacked fruit
128 (3 Sept. 1970)			
Mature dry fruits	214	51.9	1.77
Mature moist fruits	73	53.4	1.36
Immature to full-sized milk seeds	247	27.5	1.19
Aborted	0		
TOTAL	534	48.8	1.44
257 (26 Oct. 1970)			
Mature dry fruits	59	55.9	1.70
Mature moist fruits	6	16.6	1.00
Aborted	37	0	not applicable
258 (26 Oct. 1970)			
Mature dry fruits	75	66.6	1.60
259 (26 Oct. 1970)			
Immature to full-sized milk seeds	75	56.0	2.14

What difference does it make to the parent plant whether one or more weevils attack a given fruit? Probably little or none, depending on the degree of insolation. In the sample from tree 128, a single weevil per fruit destroyed 24.4% of the seeds (n = 32), 2 per fruit destroyed 47.24% (n = 18), 3 per fruit destroyed 86.1% (n = 15), and if there were 4 or more weevils per fruit all seeds were always destroyed. However, an attack with subsequent exit by even one weevil can lead to the subsequent entry by moth larvae (*Synanthedon* sp.), fungi, rain water, and various fruit scavengers long before the fruit is ready to dehisce. At the time we sampled tree 128, 9% of the fruits with exit holes had already been invaded by something, resulting in loss of the remaining seeds. In fruits collected in the less insolated and more humid forest subcanopy, virtually all with exit holes were wet inside and/or had animals in them.

ACKNOWLEDGMENTS

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* * *

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—Paul P. Shubeck

THE FAMILY PTEROGENIIDAE, WITH NOTES ON THE PHYLOGENY OF THE HETEROMERA

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Abstract

The larva of *Pterogenius nietneri* Candeze and the larva and pupa of *Histanocerus pubescens* Motschulsky are described. The family Pterogeniidae is characterized on the basis of adult and larva. The Pterogeniidae are reviewed, with keys and descriptions of new species. A discussion is presented of some of the major adult and larval characters used in the classification of Heteromera, and comments are made on the major lineages. The phylogenetic position of the Pterogeniidae is discussed. The following species are described as new: *Pterogenius besucheti*, *Histanocerus fleaglei*, *H. minutus*, and *H. werneri*. The following new combinations are made: *Histanocerus abnormis* (Gebien) and *H. drescheri* (Pic).

Introduction

The family Pterogeniidae was proposed by Crowson (1955) for two peculiar genera from southeast Asia, *Pterogenius* Candeze and *Histanocerus* Motschulsky (=*Labidocera* Gebien). Crowson considered these beetles to be among the more primitive groups of Heteromera with a possible relationship to the Ciidae. The larva of *Pterogenius nietneri* was described by Candeze (1861), but the description was inadequate for phylogenetic purposes. I recently had the opportunity to study larvae of *P. nietneri*, as well as larvae and pupae of *Histanocerus pubescens* Motschulsky and larvae of at least one additional *Histanocerus* species. This paper includes larval and pupal descriptions, a recharacterization of the family Pterogeniidae based on adult and larval characters, a systematic review of the family with descriptions of new species, and a preliminary discussion of the morphology and evolution of the Heteromera and the relationship of the Pterogeniidae to other heteromerous families.

The terminology used in both larval and adult descriptions is discussed on pp. 44-52. In the *Histanocerus* key, TL refers to the combined lengths of elytra and pronotum (not the head), and EW refers to the greatest elytral width. Abbreviations used in the citation of specimens may be found in the acknowledgments (p. 54).

Descriptions of Immature Stages

Larva of *Pterogenius nietneri* Candeze

Body (Fig. 1) elongate, subcylindrical, slightly curved, lightly sclerotized except for head and abdominal apex, the latter bearing a pair of bifurcate urogomphi (Fig. 3). Vestiture of scattered, long setae. Length about 6mm.; width about 0.8mm.

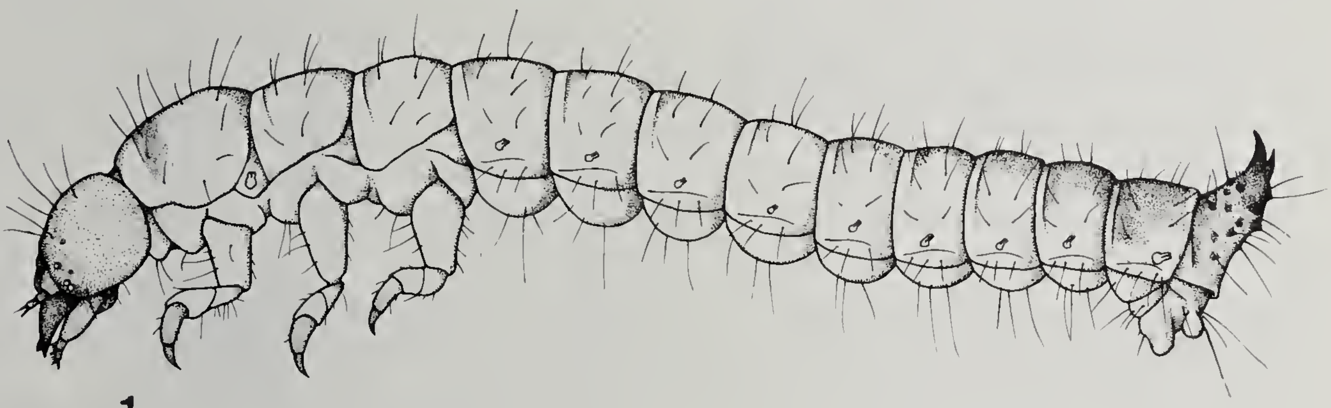
Head (Figs. 2, 6) subglobular, somewhat quadrate in dorsal view, vertex slightly flattened; moderately sclerotized and yellowish-brown in color, with very fine and sparse punctation and very lightly impressed, reticulate microsculpture; vestiture of long setae. Epicranial stem about 0.33 × as long as head width, distinctly bent to left; frontal arms lyriform, sharply diverging anteriorly and extending to just behind antennal insertions, a broad, transverse ecdysial line connecting arms anteriorly; endocarina absent. Frontoclypeal area slightly flattened, produced forward in front of heavily sclerotized mandibular articulations, pigmented except for narrow apical band; frontoclypeal suture absent, but weakly impressed, transverse sulcus may be present between articulations. Epicranial halves without ventral ridges, the ventral mouthparts supported by hypostomal ridges about 0.33 × as long as head width; hypostomal rods very short. Ocelli 5 on each side, arranged as in Fig. 1, posterodorsal ocellus often lacking pigment and not easily visible. Labrum semicircular, only slightly wider than long, with 2 basal, 2 apical, and 4 lateral setae; tormae approximate and symmetrical; epipharynx as in Fig. 24, with 3 pairs of setae at apical edge, 2 pairs basolaterally, several very fine pegs mesally, and 2 larger ones near base; base of epipharynx bearing a dense cluster of posteromesally directed hairs, which grade into an asymmetrical, open ring of stout, flattened, pharyngeal spines, bordered laterally by several transverse, overlapping plates, fringed posteriorly by fine cuticular outgrowths; base of pharynx with an additional longitudinal, median series of short spines. Antenna (Fig. 7) about 0.2 × as long as head width, 3-segmented, segments about equal in length (1.2:1:1); segment 2 narrower than 1 and bearing sensory appendix which is about as long as 3 and ventral to it; 3 about 0.25 × as wide as 2 and bearing terminal seta which is almost 3 × its length. Antennal insertion partly concealed from above by a heavily sclerotized ridge, extending from dorsal mandibular articulation to hypostomal ridge, and separated from mouth cavity by a narrow bar. Gula well-developed, elongate, separated from submentum by suture, gular sutures converging anteriorly; tentorium consisting of 2 narrow, obliquely vertical apophyses, which converge apically but do not join.

Mandibles strongly asymmetrical, large and wedge-shaped, with triangular base and 2 apical teeth. Left mandible (Figs. 17, 20) with irregularly scalloped cutting edge, deeply incised basally; mola well-developed, elongate, parallel to long axis, and concave, with 2 distal teeth and about 15 transverse ridges alternating with rows of deep pits; dorsal surface with about 10 more or less parallel rows of very small cuticular processes, those in each row arranged 3 or 4 abreast and all facing basomesally. Right mandible (Figs. 16, 18, 19) with cutting edge interrupted, forming truncate process; mola somewhat larger and oblique, convex, with about 20 ridges; dorsal rows about 13. Both mandibles with basal patch of very small spines on ventral surface, and with 2 prominent setae on outer surface. Prostheca and basal lobe absent. Maxilla (Figs. 6, 25) free almost to base of mentum, mala about twice as long as wide, its apex obliquely truncate, bearing several spines and setae, a bifurcate uncus at inner third, and two subapical heavy spines at inner angle; dorsal surface with median row of setae extending to base of palpifer and an inner row of spines extending onto stipes; stipes elongate, its inner edge with a single isolated spine; cardo subtriangular, transverse, undivided externally, although partly divided by an internal ridge; articulating area elongate and oval, partly overlapping submentum and mentum; palp 3-segmented. Labium (Figs. 6, 8) with small, trapezoidal submentum, elongate mentum, short, quadrate prementum, and well-developed ligula bearing 2 setae at apex; palp 2-segmented. Hypopharyngeal sclerome consisting of transverse plate bearing 2 lateral wings (median portions of bracon), an asymmetrical, mola-like structure at apex of plate, 2 brushes of setae anterior to this, and another brush in its center.

Prothorax slightly longer than meso- or metathorax, tergum moderately pigmented at anterior end without transverse carina, with anterior and posterior row of long setae and scattered short setae; cervicosternum well-developed, bearing 2 setae, basisternum with 2 approximate setae near anterior end; coxal bases large and oval, separated by about 0.5 diameter. Meso- and metathoracic terga very lightly pigmented except for fine, transverse carina near anterior end, each with median, transverse row of long setae and anterior row of shorter ones; mesothoracic laterotergite bearing annular-biforous spiracle with accessory chambers facing dorsally and about as long as diameter of peritreme. Legs about equal in size and 0.75 × as long as thoracic width, each armed with a number of setae of varying lengths; coxa large and conical, anteriorly with 3 moderately long setae; femur slightly longer than tibia; tarsungulus with 2 setae of unequal lengths.

Abdomen about 1.8 × as long as thorax, segments 1 to 7 very lightly pigmented, each tergal plate with anterior carina, posterior row of longer setae, and anterior row of shorter ones; spiracles smaller than those of thorax, annular-biforous, with accessory chambers directed posterodorsally at a 45° angle, situated above the transverse laterotergites which bear 1 long and 2 or 3 shorter setae, more or less in a transverse row. Abdominal sterna with a single transverse row of long setae and several shorter setae. Tergum 8 more heavily pigmented, with anterior carina and 2 setal rows as in anterior segments, but with larger spiracle, whose accessory chambers form a slightly greater angle with the vertical axis. Tergum 9 (Fig. 3) lightly pigmented, except for pair of bifurcate urogomphi and a number of setiferous tubercles. Sterna 8 and 9 reduced in length, strongly transverse, each bearing a single row of setae. Segment 10 facing posteroventrally, tergum and sternum crescent shaped, with row of setae near apex; anus surrounded by 1 posterior and 5 anterior papillae, the lateral members of anterior group with outer patch of asperities.

Material examined. Series of about 25 specimens collected with adults by sifting in virgin forest near Hagkala, 1700-1800m, central CEYLON, Jan. 28, 1970, C. Besuchet and I. Löbl, coll. [MHNG]; 5 specimens collected with Berlese funnels at Kanda-ela Reservoir, 6200 ft., 5.6 mi. SW Nuwara Eliya, Northeast District, CEYLON, Feb. 10-12, 1970, D. Davis and W. Rowe [USNM]; 3 specimens collected with adults in polypore fungus at Peradeniya, CEYLON, 1910, Petch coll. [MCZC].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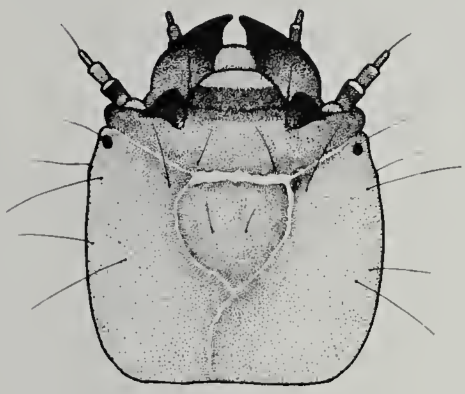
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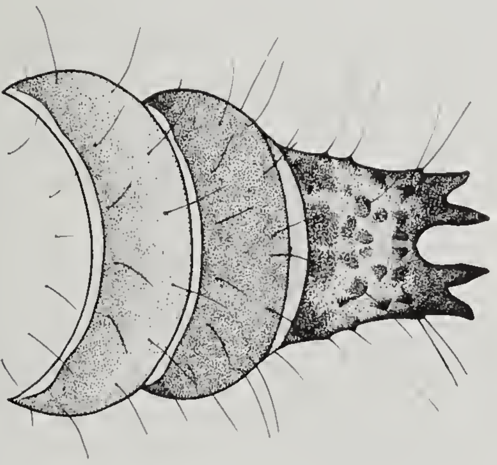
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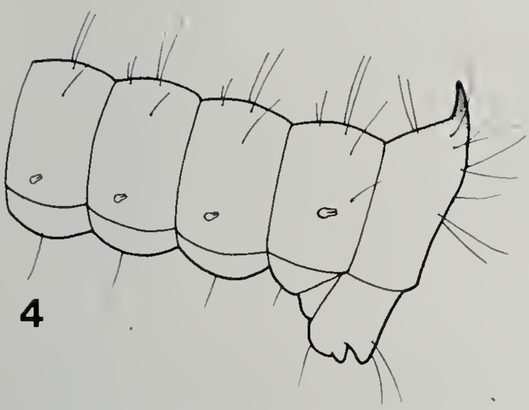
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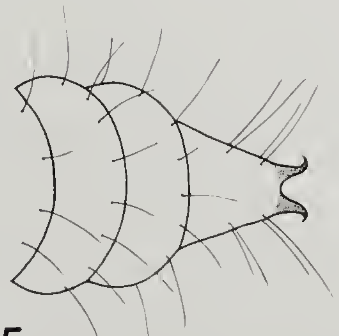
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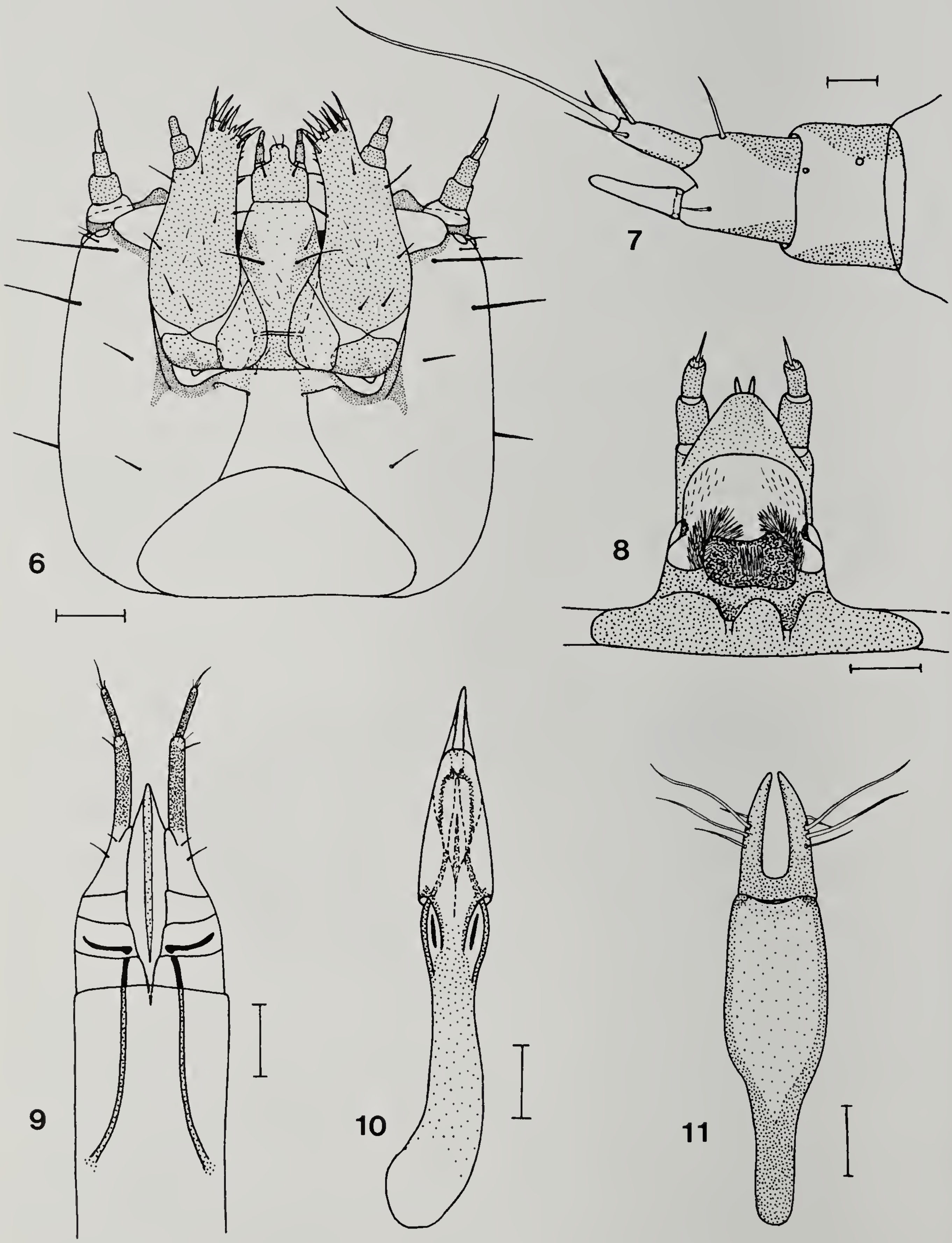
Figs. 1-3. *Pterogenius nietneri.* 1) Larva, lateral. 2) Larval head capsule, dorsal. 3) Larval abdominal apex, dorsal. Figs. 4-5. *Histanocerus pubescens.* 4) Larval abdominal apex, lateral. 5) Same, dorsal.

It should be noted that the two large spines at the inner apical angle of the mala are somewhat set off from the other apical armature and arise slightly below the apex. These could be interpreted as homologues of the spines borne on the laciniar lobe in Ciidae.



Figs. 6-11. *Pterogenius nietneri.* 6) Larval head capsule, ventral, mandibles and labrum removed. 7) Larval antenna, mesal. 8) Larval hypopharynx, dorsal. 9) Ovipositor, ventral. 10) Median lobe, ventral. 11) Tegmen, ventral. (1 line = 0.08mm. for 6; 0.06mm. for 7; 0.025mm. for 8; 0.125mm. for 9-11).

Larva of *Histanocerus pubescens* Motschulsky

Body more lightly sclerotized than that of *P. nietneri*, with simple, approximate urogomphi (Figs. 4-5). Length about 4mm.; width about 0.5mm. Details more or less as in *P. nietneri*, except as noted below.

Head yellowish in color; epicranial stem longer, about 0.4 × as long as head width, bent to left. Ocelli 4 on each side, arranged more or less as in *P. nietneri*, without reduced, posterodorsal ocellus. Antenna with sensory appendix distinctly longer than segment 3. Mandibles (Figs. 21-23) with fewer rows of dorsal cuticular processes; molar surface with finer transverse ridges and smaller pits between the ridges. Prothoracic tergum with pigment restricted to narrow anterior band, with distinct row of long setae at anterior end and a few short setae at posterior end. Meso- and metaterga and abdominal terga 1 to 8 devoid of pigment, each with transverse rows of longer and shorter setae. Legs shorter and broader than in *P. nietneri*, bearing short and stout setae or spines, each procoxa with a single, anteriorly projecting long seta. Tergum 9 (Figs. 4-5) unpigmented except for tips of urogomphi, which are simple and approximate, bearing a number of long setae.

Material examined. About 50 specimens collected with adults in the fruiting bodies of *Ganoderma* sp. in the Krau Game Reserve, Temerloh District, Pahang, MALAYSIA, Aug. 2, 1973, and Aug. 29, 1974, Lots 3484, 3717, and 3721 J. F. Lawrence (J. Fleagle, collector) [MCZC].

This larva and that of *Pterogenius* have an overall resemblance to those of Byturidae, Tetratomidae, Melandryidae, Ciidae, Colydiidae, and some clavicorn families such as Languriidae and Erotylidae. These are all relatively small forms, subcylindrical in cross-section, with distinct urogomphi, and a posteroventral, pygopod-like tenth segment, and they usually inhabit rotten wood or fungal fruiting bodies. Byturidae and the Clavicornia have a cylindrical, rather than transverse tenth segment and at least remnants of a mandibular prostheca. The distinctive head, with a bowed epicranial stem and transverse ecdysial line, the asymmetrical mandibles with a distinctive molar surface, and the enlarged 8th spiracle serve to distinguish pterogeniids from all of the above forms. Mycetophagid and archeocrypticid larvae have certain resemblances to pterogeniids, but in both groups the body is more flattened and the tenth segment more transverse and posteriorly oriented. The less flattened larvae in the pythid-salpingid group are easily distinguished by the presence of basal asperities on sternite 9.

The mandibles of pterogeniids are of a highly specialized, grinding type, analagous to the teeth of elephants. The numerous transverse molar ridges form multiple shearing surfaces used to cut reinforced polypore hyphae into small sections. The peculiarly bent epicranial stem may be associated with the distribution of muscle masses operating the highly asymmetrical mandibles.

Pupa of *Histanocerus pubescens* Motschulsky

Body (Fig. 26) lightly pigmented, except for pronotal club, barbed processes on thoracic and abdominal terga, elytral apices, urogomphi, and major setae, all of which are yellowish-brown to dark brown in color. Vestiture consisting of major setae, all of which are darkly pigmented and borne on raised, conical processes, and scattered, shorter or lightly pigmented setae. Head with 4 paramedian pairs of major setae, 1 on each side of vertex, 2 in front of eye, and 1 on each eye. Pronotum bearing on its anterior edge a complex, club-like process (Fig. 27) consisting of a number of pigmented barbs and setae; center of disc with 3 pairs of pigmented, posteriorly-curved, barbed processes, each bearing a seta near the base, 7 discal and 11 marginal major setae on each side of barbed processes. Meso- and metaterga each with a pair of paramedian, barbed processes, and 2 major setae on each side of these. Abdominal terga 1 to 7 each with a pair of barbed processes each bearing a seta which is close to the apex, 2 major setae on each side, and a lateral seta, which is particularly long and borne on a well-developed process. Abdominal tergum 8 without barbed processes, with 3 major setae on each side (including lateral seta). Ninth tergum with a pair of fine, simple, darkly-pigmented, widely separated urogomphi, and 4 major setae below the urogomphi on each side. Sterna each with a paramedian pair of lightly pigmented, long, fine setae. Elytral pads each with several major setae and a barbed process at the apex.

Material examined. Three pupae collected with a series of larvae and teneral adults in fruiting bodies of *Ganoderma* sp. in the Krau Game Reserve, Temerloh District, Pahang, MALAYSIA, Aug. 29, 1974, Lot 3721 J. F. Lawrence (J. Fleagle, collector) [MCZC].

FAMILY CHARACTERIZATION

Family PTEROGENIIDAE

Pterogeniidae Crowson 1955: 124.

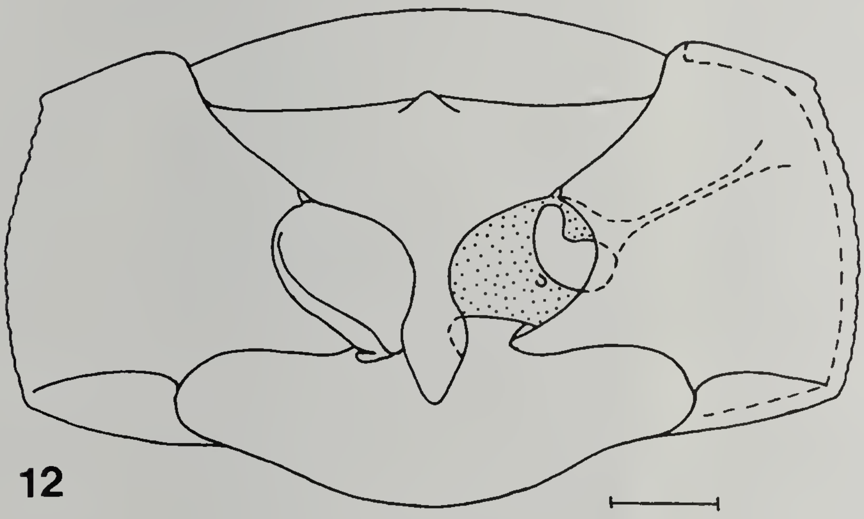
With the general characters of Polyphaga: Cucujoidea.

Adult. Form oval to oblong, convex; length 1.5-3.5mm. Head globular, without neck, inclined and partly concealed by pronotum, without stridulatory files on occiput. Eye relatively small, coarsely facetted, oval to deeply emarginate, always bordered posteriorly by lateral outgrowth of head, occasionally (males of *Pterogenius*) greatly distorted by lateral expansion of frons. Frontal region flat or slightly concave, in *Histanocerus* with lateral collosities, in *Pterogenius* produced and elevated at apex and expanded laterally in male; frontoclypeal suture distinct; antennal insertions exposed (*Histanocerus*) or concealed (*Pterogenius*). Clypeus small, oval, lying in median emargination of frons and about 0.2 × its width, in male densely punctate and pubescent (*Histanocerus*) or impunctate and bearing pubescent fovea (*Pterogenius*, Figs. 28-29). Antennae 11-segmented, with very weak (*Pterogenius*) or strong (*Histanocerus*) 3- to 6-segmented, gradual club (Figs. 28-31); first antennal segment at least twice as long as second, in *Histanocerus* longer and asymmetrical, bearing apical process which may be curved or hooked (Figs. 15, 30-31). Mouthparts small relative to size of head, mouth cavity being less than half as wide as head behind eyes. Labrum semicircular, joined to clypeus by visible membrane. Mandibles wedge-like, with broad base, two apical teeth, membranous, hairy prostheca, similar basal lobe, extensive mola consisting of fine, transverse ridges, and slightly concave outer surface, bearing numerous hairs. Maxilla with 2-segmented, brush-like galea and articulated lacinia without apical hook; palp 4-segmented, the apical segment securiform. Labium with well-developed, broad ligula and 3-segmented palp. Gula strongly narrowed anteriorly.

Prothorax (Fig. 12) strongly transverse, lateral margins distinct with edges finely crenulate, base weakly bisinuate, not margined, anterior edge truncate. Prosternum short, strongly tumid, intercoxal process moderately broad, slightly expanded behind coxae, narrowly rounded and depressed at apex, fitting into depression on mesosternum. Procoxae slightly transverse, without internalized, lateral extensions, trochantin concealed, very small, and fused to coxal cowling; procoxal cavities closed internally, open externally. Scutellum transverse. Elytra not striate, with confused punctation and weak humeral calli, lateral edge of each with reflexed margin and broad epipleuron which extends to apex. Hindwing (Crowson 1955: fig. 159) with Media reduced and with 4 veins in the "anal" group, the first of which bisects the subcubital fleck. Mesosternum (Fig. 13) slightly convex, about as long as wide, with shallow, smooth, triangular depression at anterior edge; intercoxal process notched at apex, extending posteriorly beyond middle of coxae, which are globular and distinctly separated; coxal cavities not closed outwardly by sterna (mesepimera reaching cavities); trochantin exposed. Metasternum (Fig. 13) transverse, convex, flat in middle; median suture distinct, about 0.67 × as long as sternum; a pair of transverse ridges just in front of hind coxae, which are strongly transverse and narrowly separated. Metendosternite (Crowson 1944: fig. 76) with narrow stalk, reduced lamina, and anterior tendons located beyond middle of narrow arms. Tarsomeres 5-5-4 in both sexes, simple, subequal, except for last, which is as long as others taken together; claws simple, empodium well-developed, bearing 2 long setae. Trochanters weakly heteromeroid. Apices of all tibiae with 2 inner spurs and several spines; outer apical angle of protibia in *Histanocerus* (Fig. 14) expanded and bearing several stout spines.

Abdomen with 5 visible sternites, the first two (segments 3 and 4) connate, the first without lines or ridges. Sternite 7 unmodified, 8th sternite with short, median, basal strut, 9th segment with membranous apex, lateral struts joined for a short distance at base. Aedeagus (Figs. 10-11) of the inverted heteromeroid type, with elongate, ventral, basal piece, tegmen deeply divided forming two widely separated parameres converging at apices, and long, narrow, median lobe, with complex apical region. Ovipositor (Fig. 9) elongate, paraprocts and proctiger with supporting rods, coxite 3-segmented, terminal segment elongate, its apical portion narrow, extending well beyond vulva, more heavily sclerotized than base, almost glabrous except at apex; stylus terminal, elongate, heavily sclerotized. Spermatheca simple (*Histanocerus*) or convoluted (*Pterogenius*), its apex inclosed by a dome-like structure.

Pupa. See description on p. 29.



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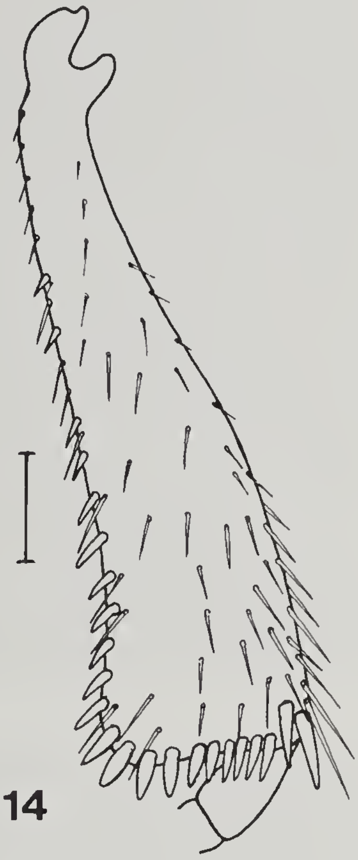

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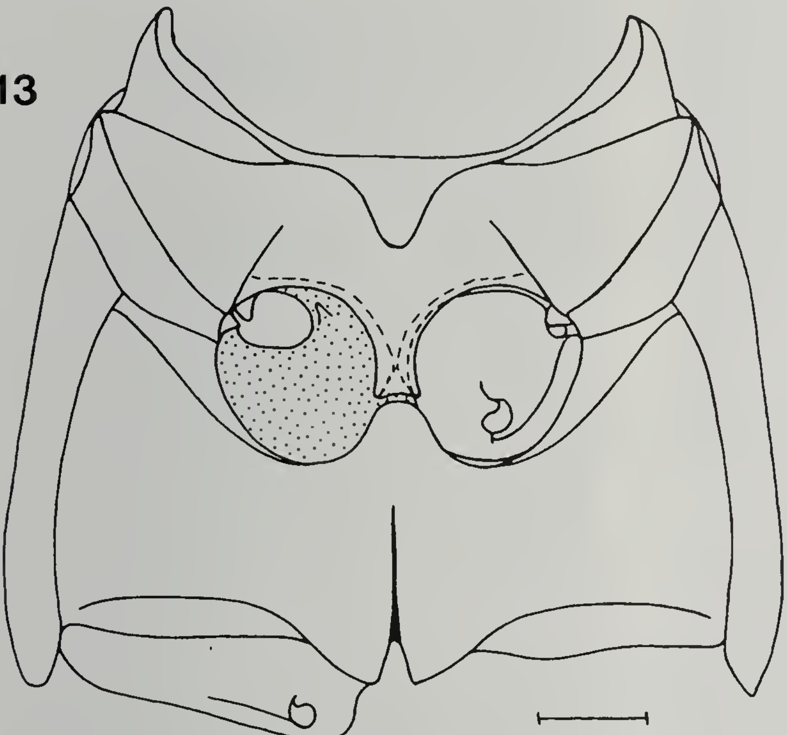

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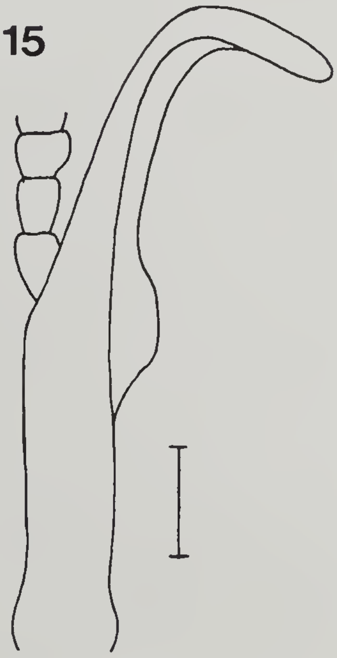

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Figs. 12-13. *Pterogenius nietneri*. Adult male. 12) Prothorax, ventral view, left procoxa removed. 13) Pterothorax, ventral, right mesocoxa and left metacoxa removed. Fig. 14. *Histanocerus pubescens*. Adult male, left protibia, posterior. Fig. 15. *H. fleaglei*. Adult male, left antenna, segments 1-4, dorsal. (1 line = 0.125mm. for 12, 13, 15; 0.06mm. for 14).

Larva. (See figures for larval descriptions). Body elongate and subcylindrical, lightly sclerotized except for head and abdominal apex. Head exserted, obliquely prognathous, subglobular, with epicranial stem bent to left and lyriform frontal arms connected anteriorly by transverse ecdysial line; endocarina and ventral epicranial ridges absent. Ocelli 4 or 5 on each side. Antennal insertions partly concealed by antennal ridges, separated from mouth cavity by narrow bar. Antenna, short, 3-segmented, with long sensory appendix on segment 2 and very long terminal seta. Gula well-developed and elongate, separated from submentum by suture; gular sutures distinct, converging anteriorly. Mandibles asymmetrical, large, and wedge-shaped, with triangular base and 2 apical teeth; left mandible with scalloped cutting edge, mola elongate, parallel to long axis, concave, with 2 distal teeth and several transverse ridges alternating with rows of deep pits; right mandible with truncate process on cutting edge, mola oblique and convex with similar surface; both mandibles with several rows of very fine, cuticular outgrowths on dorsal surface, and 2 stout setae on outer edge; prostheca and basal lobe absent. Maxilla free almost to base of mentum, with elongate-oval articulating area; mala obliquely truncate, armed at apex with spines and setae, an uncus at inner third, and 2 heavy subapical spines at inner angle; cardo undivided externally; palp 3-segmented. Labium with small submentum, elongate mentum, short, quadrate prementum, and well-developed ligula with 2 setae; palp 2-segmented. Hypopharynx with distinct mola-like sclerome, in front of which are 2 setal brushes. Prothorax slightly larger than meso- or metathorax; coxae large and conical, fairly close together; spiracle annular-biforous, with accessory chambers dorsal. Legs well-developed, about equal in size; tarsungulus with 2 setae. Abdominal spiracles annular-biforous, with accessory chambers posterodorsal at angle of 45°, those on 8th segment enlarged. Ninth tergum with pair of urogomphi, simple or bifurcate; 8th and 9th sterna reduced and transverse; 10th segment reduced, transverse but somewhat pygopod-like, with several anal papillae.

Adult pterogeniids are similar in general form to certain cryptophagids (*Antherophagus*) and languriids (*Cryptophilus*, *Setariola*) as well as to a number of heteromerous groups, such as Byturidae, Biphyllidae, Mycetophagidae, Tetratomidae, Ciidae, and Tenebrionidae. The securiform maxillary palps, reduced clypeus, internally closed and externally open procoxal cavities, laterally "open" mesocoxal cavities, connate 3rd and 4th abdominal segments, and inverted heteromeroid aedeagus, in combination, will distinguish them from any of the above. Distinguishing characters of the larva have been given on p. 29.

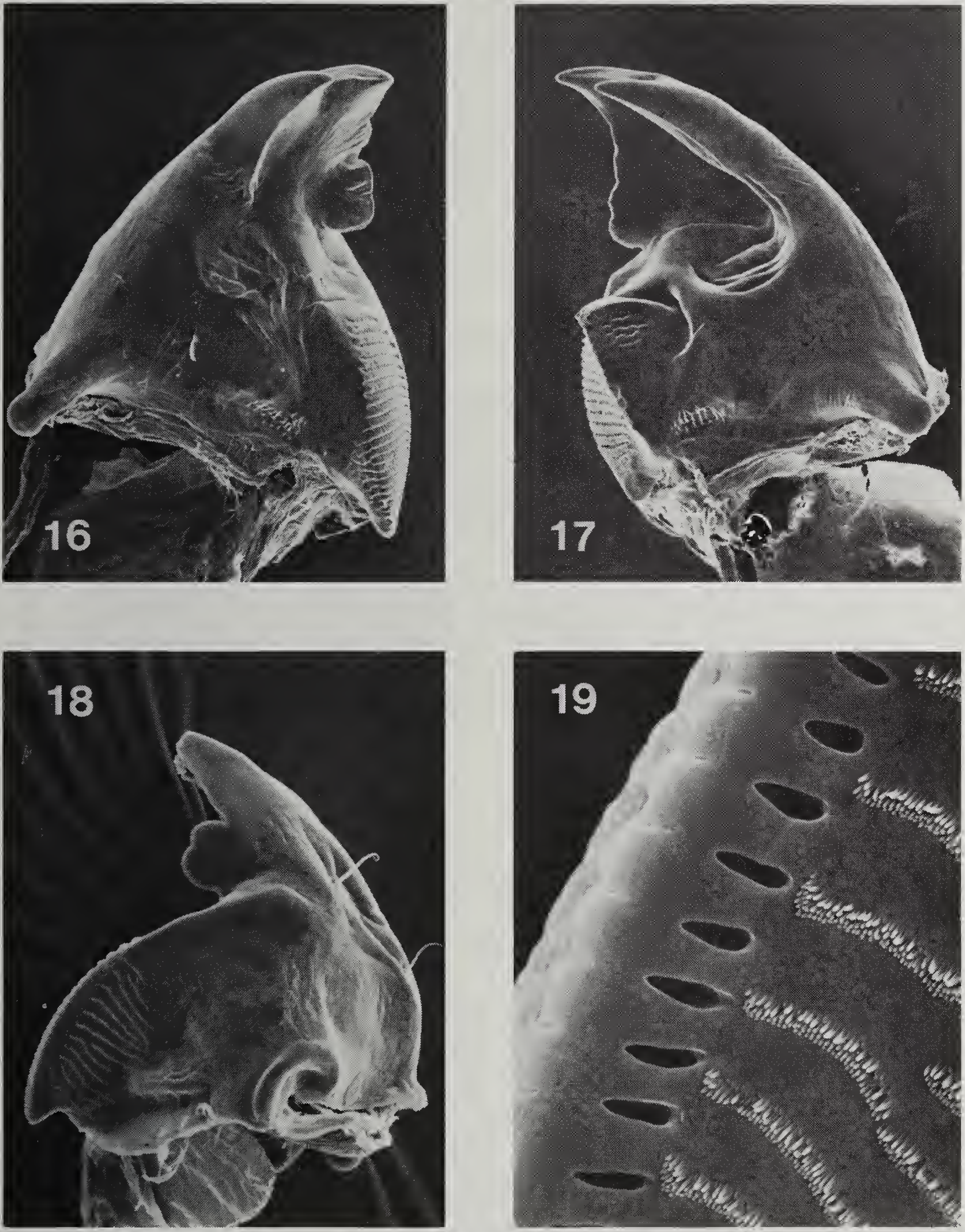
The structure of the aedeagus in *Pterogenius* and *Histanocerus* is quite similar, and differences among the species of each are minor ones. Genital characters have not been used in the descriptions or keys presented below.

SYSTEMATIC REVIEW

Key to the genera of Pterogeniidae

1. *Adult.* Antennal insertions more or less exposed; first antennal segment with apical process extending beyond articulation of segment 2 (Figs. 15, 30); antennal club distinct, its segments always transverse (Figs. 30, 31); outer apical angle of protibia expanded and bearing several stout spines (Fig. 14); head of male not laterally expanded, clypeus without pubescent fovea. *Larva.* Urogomphi simple and approximate (Figs. 4-5); sensory appendix of antenna distinctly longer than segment 3; abdominal tergum 8 unpigmented. Southeast Asia, East Indies .... *Histanocerus* Motschulsky

1'. *Adult.* Antennal insertions completely concealed from above; first antennal segment without apical process; antennal club weak, its segments not transverse; outer apical angle of protibia not expanded; head of male laterally expanded, clypeus with pubescent fovea (Figs. 28-29). *Larva.* Urogomphi bifurcate (Fig. 3); sensory appendix of antenna subequal to segment 3 (Fig. 7); abdominal tergum 8 pigmented. Ceylon........ .... *Pterogenius* Candeze



Figs. 16-19. *Pterogenius nietneri.* Larval mandibles. 16) Right mandible, ventral, 331x. 17) Left mandible, ventral, 324x. 18) Right mandible, dorsal, 350x. 19) Right mandible, section of dorsal surface adjacent to mola, 2800x.

Pterogenius Candeze

Pterogenius Candeze 1861: 363. Type species, by monotypy, *P. nietneri* Candeze.
Apogenia Pascoe 1866: 486. Unnecessary replacement name.

Members of this genus are easily distinguished by the characters given in the key. The expansion of the head in the male is particularly striking, and in the larger males of *P. nietneri* the head may exceed the prothorax in width. Although anteriorly directed horns on the head and pronotum are common in males of various Coleoptera (Ciidae, Tenebrionidae, Scarabaeidae), lateral expansion of the head is a relatively rare phenomenon. Notable examples occur in the Cerambycidae (*Tapeina transversifrons* Thomson), Erotylidae (*Zythonia fulva* Westwood), and Aglycyderidae (*Aglycyderes* spp.). This feature may be associated with male combat, but the acute and slightly elevated edge of the entire frontal region suggests the possibility of its use in the cooperative construction of egg galleries. The fovea on the clypeus is also an uncommon secondary sexual character in beetles, although foveae on the frons or vertex occur in males of several Ciidae. These structures appear to be secretory and may be associated with the production of a sex pheromone.

The two described species of *Pterogenius* are apparently restricted to the island of Ceylon (Sri Lanka).

Key to adults of described species of *Pterogenius*

1. Antennal segment 3 more than 1.3 × as long as segment 2, not curved in male; head of male greatly expanded, often broader than pronotum, bearing a pubescent fovea which is more than 0.25 × as wide as clypeus (Fig. 28); pronotal punctation very dense, the punctures confluent; size larger (usually 3mm. or more) .... *P. nietneri* Candeze

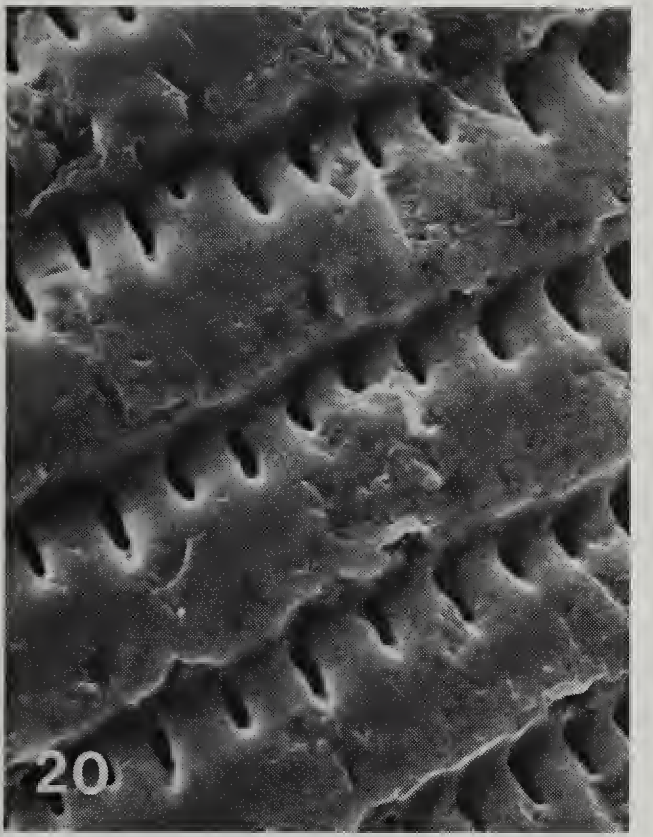
1′. Antennal segment 3 less than 1.2 × as long as segment 2, strongly curved in male (Fig. 29); head of male not as greatly expanded, bearing a pubescent fovea which is less than 0.25 × as wide as clypeus (Fig. 29); pronotal punctation not as dense, the punctures usually not confluent; size smaller (usually less than 3mm.) .... *P. besucheti* Lawrence, n. sp.

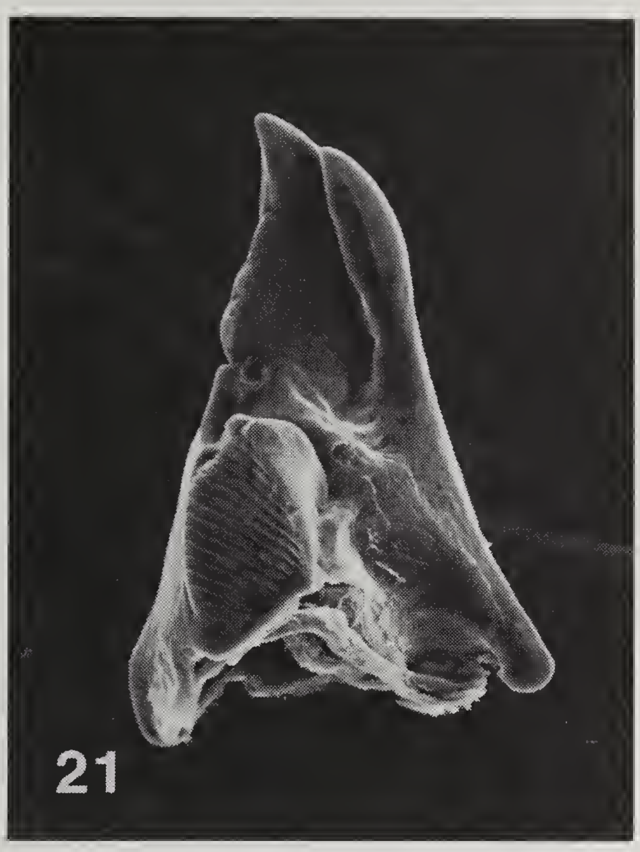
Pterogenius besucheti Lawrence, **new species**

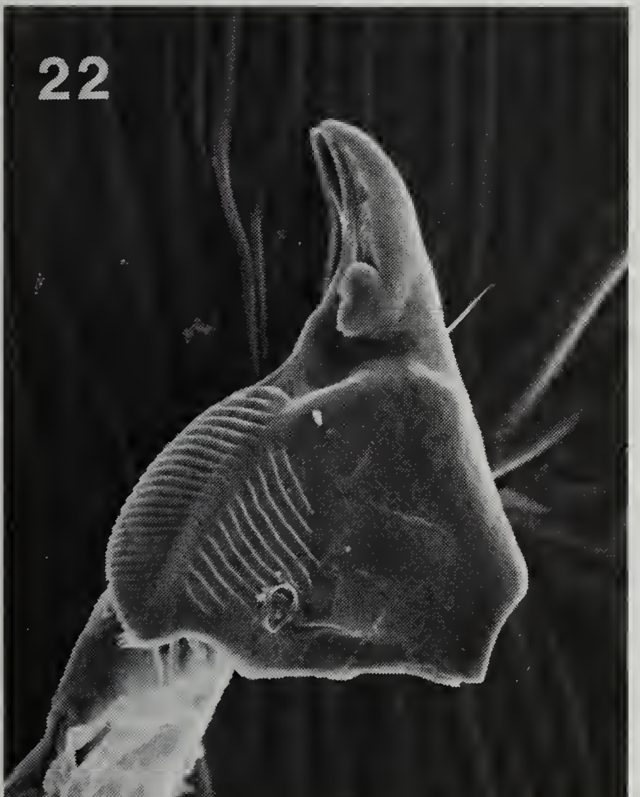
Individuals of this species are usually smaller than those of *P. nietneri*, and the pronotal punctures are less dense and not confluent; males are easily distinguished by the modifications of the third antennal segment.

Description. Length 2.3-3.0mm. Color dark reddish-brown to brownish-black, head and prothorax usually darker than elytra. Vestiture of long, fine, densely packed, inclined hairs. Head (Fig. 29) moderately to strongly expanded at sides, almost as wide as prothorax in larger males; front edge strongly arcuate in female, weakly so in male; clypeal fovea in male about 0.15 × as wide as base of clypeus, and located near apical edge. Antenna of male about 1.2 × as long as pronotal width, segment 1 twice as long as 2, segment 3 slightly longer than 2, strongly curved and narrowed at base, with glabrous upper surface; segments 4-6 slightly longer than wide, 7-11 forming a weak club; female antenna about as long as pronotal width, segment 1 about 1.6 × as long as 2, segment 3 unmodified. Pronotum about .6 × as long as wide, widest at middle, sides weakly rounded, with distinct, slightly raised margins, visible for their entire lengths from above, and irregularly crenulate edges; anterior angles almost right, posterior angles obtuse; disc moderately convex, punctation coarse and dense, but not confluent. Elytra about 1.25 × as long as wide and 2.3 × as long as pronotum, lateral margins narrow, not visible from above, except at anterior end; disc moderately convex, steeply sloping laterally, gradually so posteriorly; punctation somewhat finer than that of pronotum.

Types. Holotype, male, and allotype, female, CEYLON: Kandy, 600m., Jan. 15, 1970, Lot 3a, polypore on old tree stump (C. Besuchet and I. Löbl) [MHNG]. Paratypes: CEYLON: 13, same data as holotype [MHNG, MCZC]; 1, Ratnapura, Sabaragamuwa, Jan. 21, 1970, Lot 16b, sifted from dead leaves (C. Besuchet and I. Löbl) [MHNG].







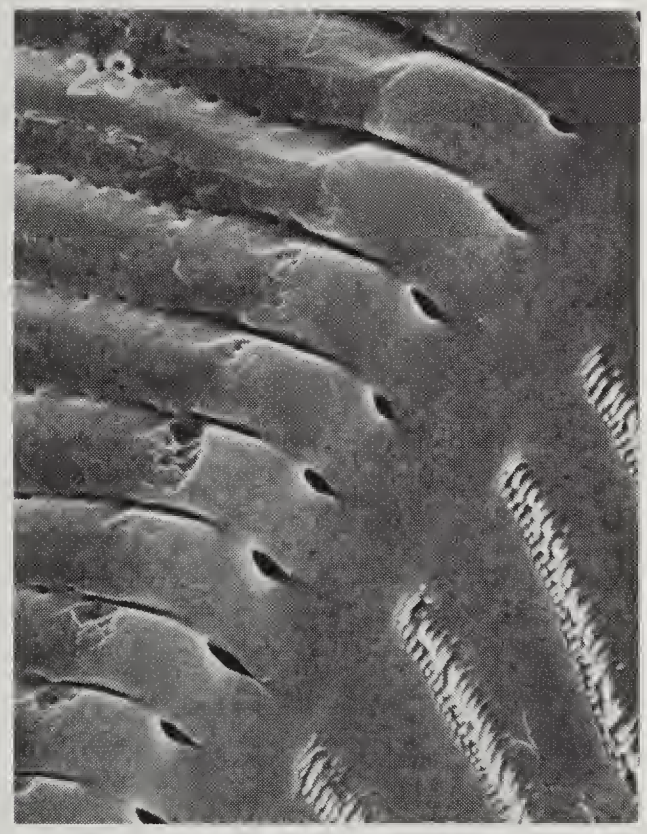


Fig. 20. *Pterogenius nietneri.* Right larval mandible, section of molar surface, 5240x. Figs. 21-23. *Histanocerus pubescens.* Larval mandibles. 21) Left mandible, mesal, 400x. 22) Right mandible, dorsal, 400x. 23) Right mandible, section of dorsal surface and adjacent mola, 4000x.

Pterogenius nietneri Candeze
(Fig. 28)

Pterogenius nietneri Candeze 1861: 364, pl. 3, fig. 8c. Type locality: Ceylon. Type not examined.

Males of this species differ from those of *P. besucheti* in having a more greatly expanded head and larger clypeal fovea and in lacking modifications on the third antennal segment (Fig. 28); both sexes may be distinguished by the very dense and confluent pronotal punctation.

Distribution. Known only from Ceylon.

Host Fungi. Dark polypore (possibly *Ganoderma* sp.). Stomach contents of a larva from Kanda-ela Reservoir consisted of large masses of brownish skeletal and binding hyphae cut into relatively small segments; no spores were seen.

Material Examined. CEYLON: 170, Hagkala, 1700-1800m., Jan. 28, 1970 (Besuchet & Löbl) [MHNG, MCZC]; 10, Kanda-ela Reservoir, 5.6 mi. SW Nuwara Eliya, 6200 ft., Feb. 10-21, 1970 (Davis & Rowe) [USNM]; 7, Peradeniya, 550m., Jan. 19, 1970 (Besuchet & Löbl) [MHNG]; 15, same locality, 1910 (Petch) [MCZC]; 1, Pidurutalagala, 2200m., Jan. 29, 1970 (Besuchet & Löbl) [MHNG].

Histanocerus Motschulsky

Histanocerus Motschulsky 1858: 112, fig. 16. Type species, by monotypy, *H. pubescens* Motschulsky.

Labidocera Gebien 1925: 117. Type species, by monotypy, *L. abnormis* Gebien.

Males and females of *Histanocerus* species are distinguished from those of *Pterogenius* by the enlarged first antennal segment, transverse antennal club segments, and expanded protibial apex. In general form they resemble members of the tenebrionid genus *Pentaphyllus*, which often occur in the same habitats, but *Pentaphyllus* have the eyes large and more coarsely facetted, the procoxal cavities closed behind, the first 3 visible abdominal sternites fused, and the first antennal segment unmodified. The asymmetrically lengthened first antennal segment of *Histanocerus* males is a relatively uncommon secondary sexual character, although it does occur in a number of laemophloeine Cucujidae. The structure may be involved in courtship, but it is also possible that it is used in male combat, as are the head and pronotal horns in other small fungus beetles (Tenebrionidae, Ciidae). Another peculiar feature occurring only in the *H. pubescens* section of the genus is the cavity formed between the reflexed anterolateral margin of the elytra and the humeral callus; this cavity is glabrous and shiny, in contrast to the surrounding area, and in several Malaysian specimens the cavity was occupied by one or two mites in the hypopial stage.

Specimens of *Histanocerus* have been seen from Malaysia, Java, Sumatra, Mindanao, and the Solomon Islands. A unique female from Shortland Island and some additional specimens from Mindanao were not described because of lack of adequate material. It is quite possible that the genus is more widespread in Southeast Asia and may also occur in New Guinea.

Both adults and larvae of *Histanocerus* occur in and feed upon the hyphal tissue of woody polypores, such as *Ganoderma* and *Trametes*. They are usually accompanied by bolitophagine and pentaphylline Tenebrionidae (*Bolitonaeus*, *Pentaphyllus*, etc.) and various species of Ciidae.

Key to adults of the described species of *Histanocerus*

(excluding *H. drescheri* (Pic); *see* p. 38)

1. Each elytron with an impunctate, anterolateral cavity between the humerus and epipleural carina; body more elongate (Fig. 31), TL/EW more than 1.7 2

1′. Elytra without cavities; body shorter and broader (Fig. 30), TL/EW less than 1.7 4

2(1). Antennal club 3-segmented; body smaller and more elongate, length less than 1.8mm. and TL/EW more than 2.0 .... *H. minutus* Lawrence, n. sp.

2′. Antennal club with more than 4 segments; length more than 2mm. or TL/EW less than 1.95 3

3(2″). Antennal club 6-segmented; length usually more than 2.4mm.; punctation and pubescence denser; TL/EW usually more than 1.9; Philippines .... *H. werneri* Lawrence, n. sp.

3′. Antennal club 5-segmented; length usually less than 2.4mm.; punctation and pubescence sparser; TL/EW usually less than 1.9 .... *H. pubescens* Motschulsky

4(2′). Prothoracic hypomeron punctate throughout; pronotal disc weakly arched anteriorly; elytral vestiture distinctly dual, with dense, decumbent hairs and sparser, erect ones; first antennal segment in the largest males only slightly hooked at apex (Fig. 30) .... *H. abnormis* (Gebien)

4′. Prothoracic hypomeron with an impunctate and strigose area in its center; pronotal disc strongly arched anteriorly; elytral vestiture more uniform, all hairs more or less suberect and differing only slightly in angle of inclination; first antennal segment in largest males distinctly hooked at apex (Fig. 15) .... *H. fleaglei* Lawrence, n. sp.

Histanocerus abnormis (Gebien), **new combination**

(Fig. 31)

Labidocera abnormis Gebien 1925: 119, pl. 1, fig. 4. Type locality: Si-Oban I., Mentawei Group, SUMATRA. Cotype, female, examined [MGFT].

This species differs from *H. pubescens, H. werneri,* and *H. minutus* by the short, broad body and the absence of a subhumeral, elytral cavity. From *H. fleaglei* it is distinguished by the weakly arched pronotum, less distinctly dual vestiture, and less strongly hooked apex on the first antennal segment in the male. Specimens from Java and Sumatra differ slightly from Malaysian individuals, being somewhat larger and more robust.

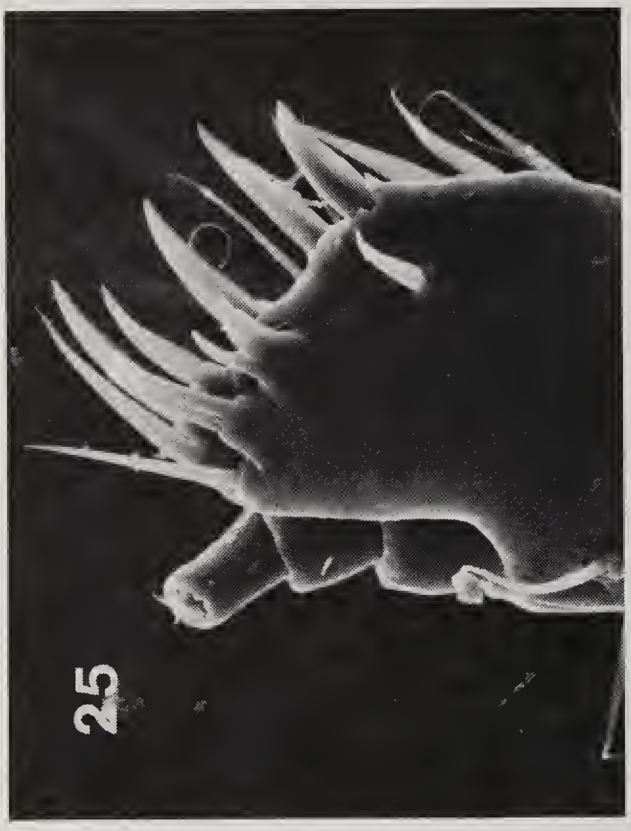
Distribution. Sumatra, Java, Malaysia. Specimens examined from Mentawei, Sumatra [MGFT]; Fort de Kock, Sumatra [MGFT, USNM]; and Krau Game Reserve, Temerloh District, Pahang, Malaysia [MCZC]. Gebien cotype (not examined) from Tjompea, Java.

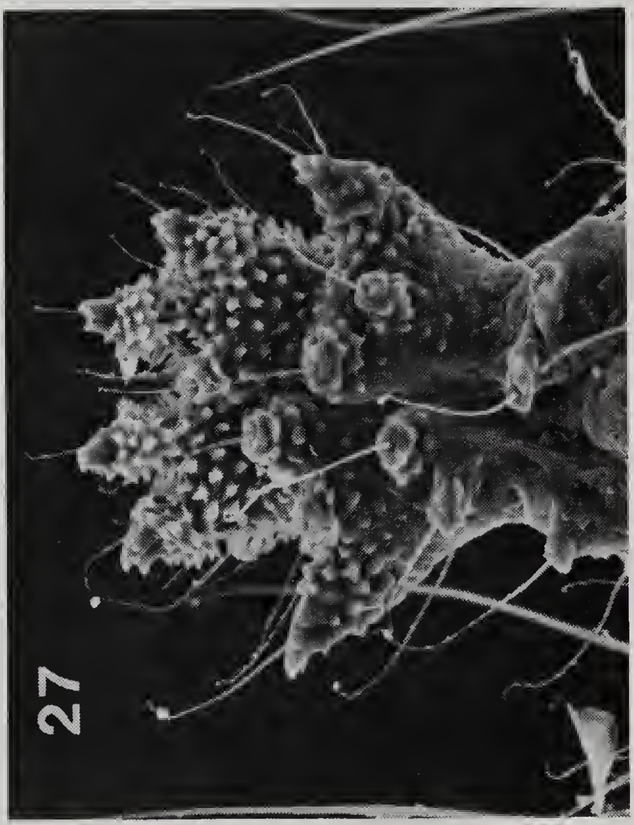
Host Fungi. Trametes scabrosa (series with larvae); *Ganoderma* sp. (1 specimen).

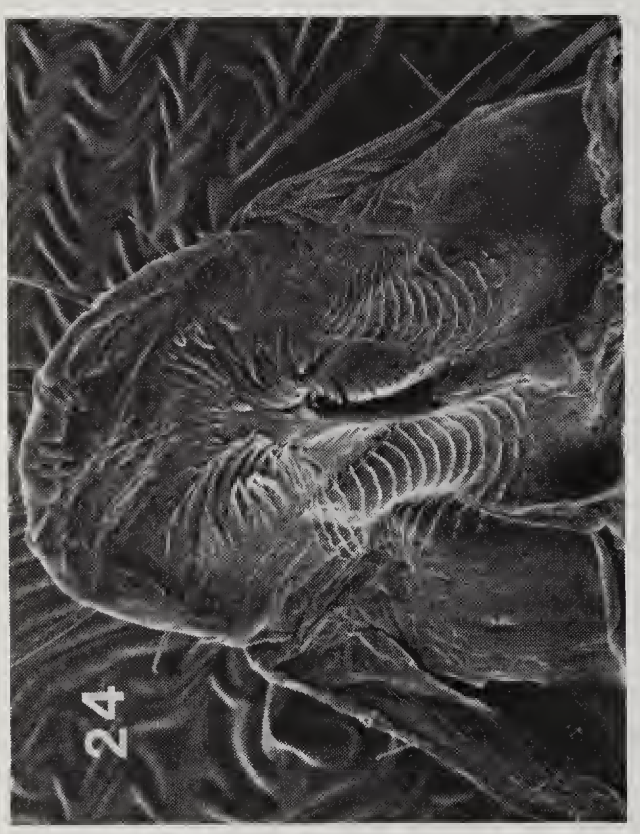
Histanocerus drescheri (Pic), **new combination**

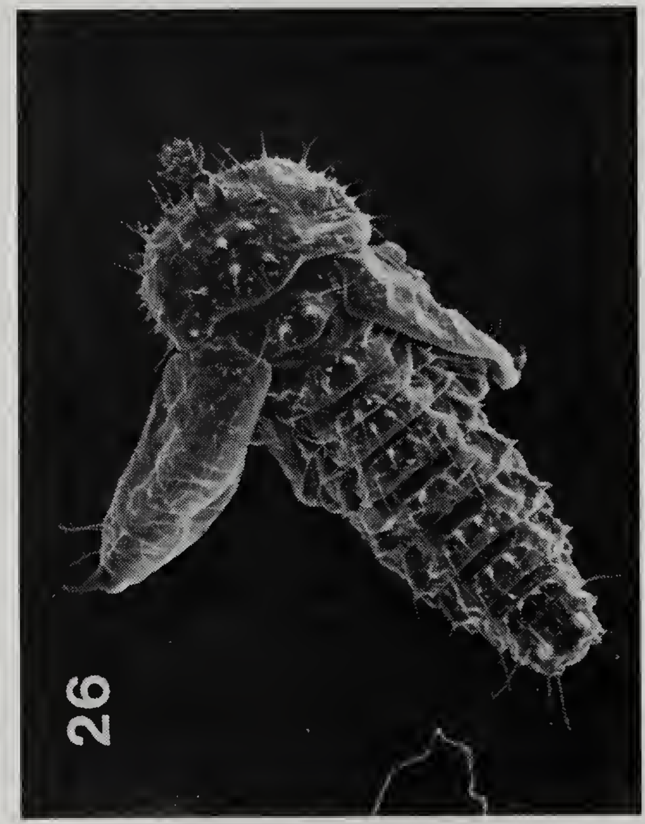
Labidocera drescheri Pic 1937:304. Type locality: Goenoeng Tangkoeban Prahoe, JAVA. Types in Museum National d'Histoire Naturelle, Paris (not examined).

This species was not included in the key, since the types were not available for study. According to Pic's description, the species is larger than most *Histanocerus* (2.5—3.5 mm.), and differs from *H. abnormis* in being less robust with the thorax less transverse. The species is most similar to *H. pubescens* and *H. werneri* in general body form.





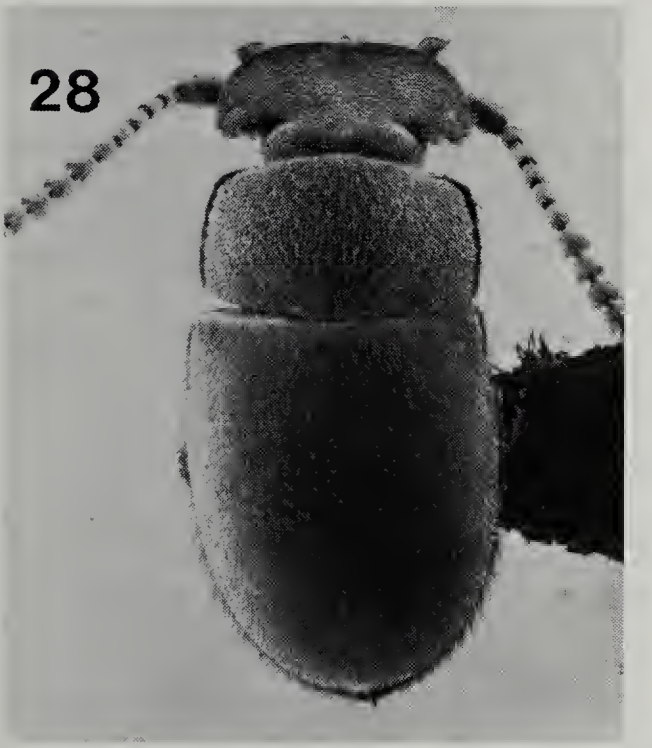


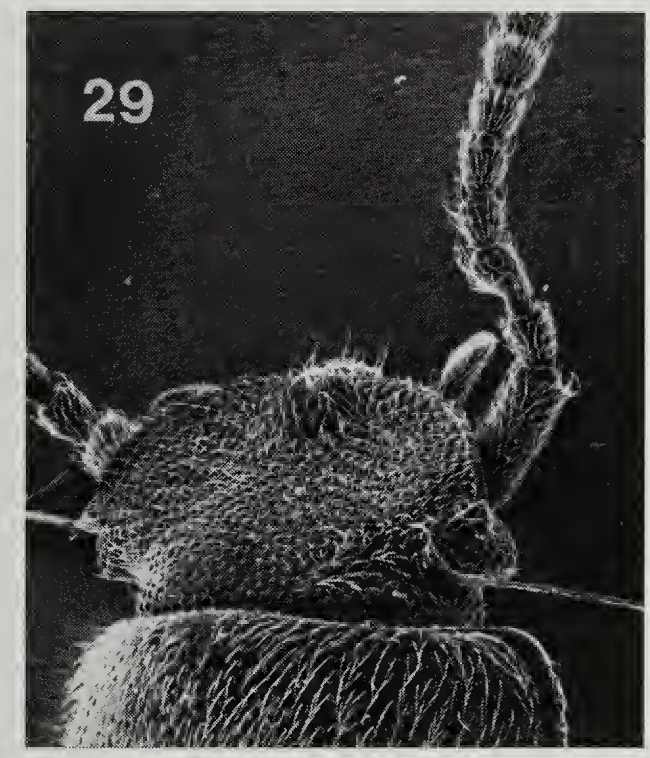


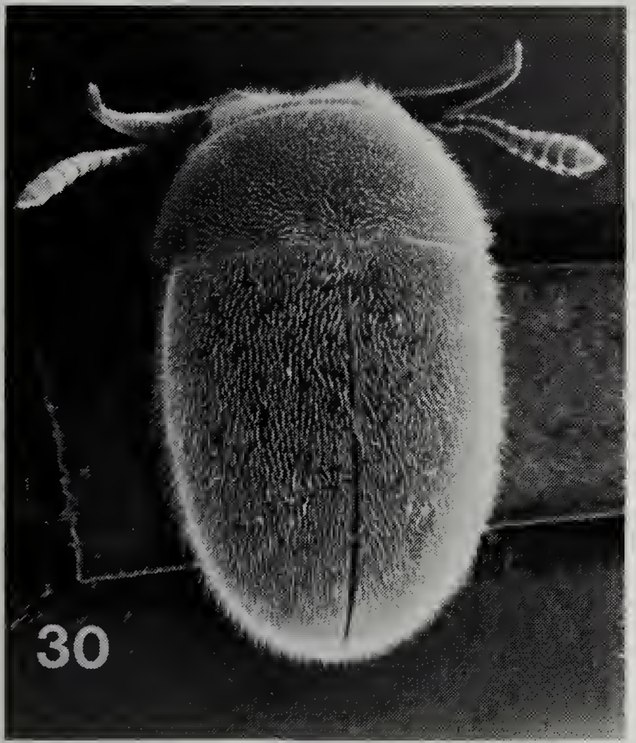
Figs. 24-25. *Pterogenius nietneri*. Larva. 24) Epipharynx and pharynx, ventral, 340x. 25) Apex of right mala, anteromesal, 587x. Figs. 26-27. *Histanocerus pubescens*. 26) Pupa, dorsal, 39x. 27) Pupal thoracic club, 403x.

Histanocerus fleaglei Lawrence, **new species**

This species is distinguished from members of the *H. pubescens* group by the absence of a subhumeral elytral cavity, gradually expanded epipleura, and shorter and broader body form. From *H. abnormis* it differs in having a smooth, shiny area on the hypomeron, larger pronotal punctures, a more strongly arched pronotum in the male, and a more distinctly hooked apex on the first segment of the male antenna.







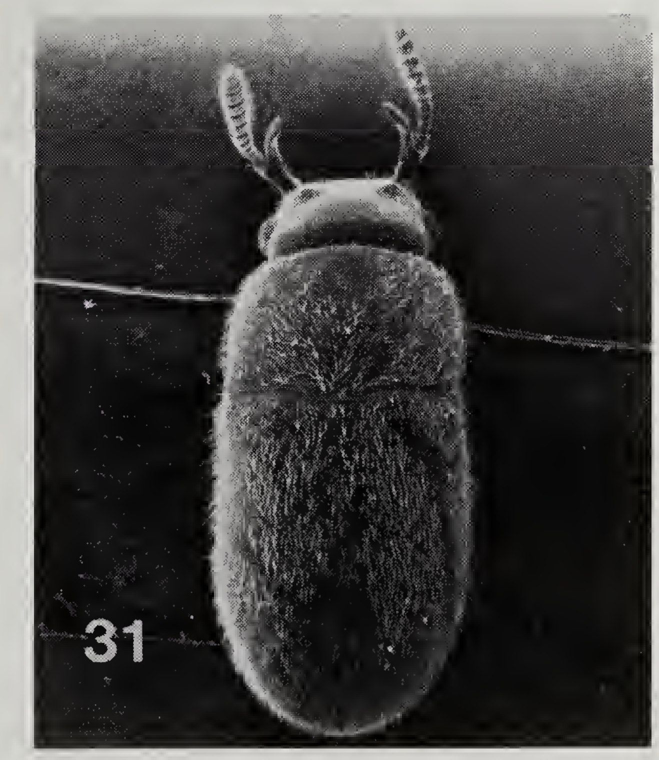


Fig. 28. *Pterogenius nietneri.* Adult male. Fig. 29. *P. besucheti.* Adult male, head and pronotal apex. Fig. 30. *Histanocerus abnormis.* Adult male. Fig. 31. *H. werneri,* adult male.

Description. Length 1.85–2.40 mm. Color yellowish brown to dark reddish-brown, head and prothorax usually darker than elytra. Vestiture of long, fine, moderately dense, subdecumbent yellowish hairs, mixed with sparsely scattered suberect hairs in rows on elytra. Head strongly declined, flat in female, in male vertex concave and frontoclypeal region with strongly raised callosities over antennal insertions. Antenna of male with segment 1 strongly curved and hooked at apex, the tip narrowly rounded, not notched (Fig. 15); antennal club 5-segmented. Pronotum about 0.53 × as long as wide, widest at basal fourth, sides gradually converging towards apex, with narrow, slightly raised margins, not entirely visible from above, and smooth edges; disc strongly convex, in male steeply sloping anteriorly; punctation moderately coarse and dense, punctures distinctly larger than eye facets and separated by 0.5 to 1 diameter. Elytra about 1.14 × as long as wide and 2.19 × as long as pronotum, widest near anterior edge, sides gradually converging posteriorly; lateral margins narrow and finely serrate; disc moderately convex, subhumeral cavities absent; punctation about the same as on pronotum. Hypomeron with a smooth, shiny area in center, just laterad of coxa. Protibia strongly expanded at apex, outer angle with several short spines. Metasternum 0.30 × as long as wide. Elytral epipleura gradually expanded at anterior end.

Types. Holotype, male, and allotype, female, MALAYSIA: Selangor: Lima Blas Estates, Jan. 15, 1975, Lot 3745 J. F. Lawrence (J. Fleagle, coll.), ex *Amauroderma rugosum* (Blume and Nees) Doidge [MCZ No. 32292]. Paratypes: MALAYSIA: Selangor: 14, same data as holotype [FMNH, MCZC, USNM]; 3, same locality, date, collector, Lot 3748 J. F. Lawrence, ex *Ganoderma* sp. [MCZC].

Histanocerus minutus Lawrence, **new species**

Individuals of this species resemble those of *H. werneri* in general body form, punctation, and pubescence, but are easily recognized by the small size and 3-segmented antennal club.

Description. Length 1.75 mm. Color of head and prothorax reddish-brown, elytra dark yellowish-brown. Vestiture of long, fine, dense, subdecumbent, yellowish hairs. Head moderately declined, vertex flat, frontoclypeal region in male with weak callosities over antennal insertions. Antenna of male with segment 1 slightly curved and subacute at apex; antennal club 3-segmented. Pronotum 0.62 × as long as wide, widest at middle, sides weakly rounded, with narrow, slightly raised margins, visible for their entire lengths from above, and crenulate edges; disc slightly convex, barely sloping anteriorly; punctation fine and dense, punctures about as large as eye facets and separated by half a diameter or less. Elytra 1.37 × as long as wide and 2.20 × as long as pronotum, widest near middle, sides subparallel for anterior two-thirds, gradually converging and broadly rounded at apices; lateral margins very narrow; disc moderately convex, subhumeral cavities present. Hypomeron granulate and strigose. Protibia weakly expanded at apex, outer angle with several long spines. Metasternum 0.45 × as long as wide. Elytral epipleura abruptly expanded at anterior end.

Types. Holotype, male, and allotype, female, MALAYSIA: Pahang: Krau Game Reserve, Temerloh District, Aug. 29, 1974, Lot 3721 J. F. Lawrence (J. Fleagle, coll.), ex *Ganoderma* sp. [MCZ No. 32293]. Paratype: MALAYSIA: same data as holotype [MCZC].

Histanocerus pubescens Motschulsky

Histanocerus pubescens Motschulsky 1858: 112, fig. 16. Type locality: "Ind. or." Lectotype, male, and 9 paralectotypes examined [ZMMU].

This species is distinguished from *H. abnormis* and *H. fleaglei* by the presence of a subhumeral elytral cavity and from *H. minutus* and *H. werneri* by the less elongate body form and 5-segmented antennal club. The type series differs from Malaysian specimens only in size, the length being 2.00–2.40 mm. in the former and 1.85–2.05 mm. in the latter. Other details, including the male genitalia, do not differ significantly. In addition to a series from the Temerloh District, Pahang and the Kuala Kangsar

District, Perak [MCZC], 4 specimens from Barungkot, Upi, Cotabato Province, Mindanao [FMNH] may also belong to this species, their size range even closer to that of the type series. It is unfortunate that Motschulsky's type locality is so vague.

Distribution. Malaysia and East Indies; Philippines?

Host Fungi. Ganoderma sp.

Histanocerus werneri Lawrence, **new species**

(Fig. 31)

This species differs from members of the *H. abnormis* group by the presence of a subhumeral elytral cavity, abruptly expanded epipleura, and more elongate body form. It is distinguished from *H. pubescens* by the denser punctation and vestiture and more elongate form, from *H. minutus* by the larger size, and from both by the 6-segmented antennal club.

Description. Length 2.35–2.55 mm. Color yellowish-brown to dark reddish-brown, head and prothorax usually darker than elytra. Vestiture of long, fine, dense, subdecumbent, yellowish hairs. Head weakly declined, vertex flat, frontoclypeal region in male with strong callosities over antennal insertions. Antenna of male with segment 1 weakly curved apically, not angulate or hooked, notched at tip; antennal club 6-segmented. Pronotum about 0.59 × as long as wide, widest at middle, sides weakly rounded, with narrow, slightly raised margins, visible for their entire lengths from above, and crenulate edges; disc slightly convex, barely sloping anteriorly; punctation fine and dense, punctures about as large as eye facets and separated by less than 1 diameter. Elytra about 1.38 × as long as wide and 1.95 × as long as pronotum, widest near middle, sides subparallel for anterior two-thirds, gradually converging and broadly rounded at apices; lateral margins very narrow; disc moderately convex, subhumeral cavities present. Hypomeron granulate and strigose. Protibia weakly expanded at apex, outer angle with several long spines. Metasternum 0.45 × as long as wide. Elytral epipleura abruptly expanded at anterior end.

Types. Holotype, male, and allotype, female, PHILIPPINES: Mindanao: E. slope Mt. McKinley, 5200 ft., Davao Prov., Aug. 20, 1946, rotten woody polypore (F. G. Werner, coll.) [FMNH]. Paratypes: PHILIPPINES: Mindanao: 6, same data as holotype [FMNH, MCZC]; 2, same locality, 6500 ft., Sept. 3, 1946, Lot 43, dead polypore (F. G. Werner, coll.) [FMNH]; 3, Meran, E. slope Mt. Apo, 6000 ft., Davao Prov., Nov. 5-9, 1946, Lot 131, decayed woody polypores (F. G. Werner, coll.) [FMNH].

MORPHOLOGICAL AND EVOLUTIONARY CONSIDERATIONS

A discussion of the phylogenetic relationships of the family Pterogeniidae or any other heteromeran family is hardly possible until the phylogeny of the entire section is examined, and the latter, in turn, is dependent upon a detailed analysis of the morphological features on which this phylogeny is based. Many characters used in heteromeran classification have been vaguely defined and their use by different authors has not been consistent. Although Crowson (1955; 1960; 1966) and more recently Doyen (1972), Watt (1967; 1974a; 1974b), and others have begun to introduce new characters and to more carefully analyze the old ones, much more work of this sort is still needed.

It is beyond the scope of the present paper to provide the complete analysis called for above, but perhaps it will suffice for me to discuss briefly several of the adult and larval features commonly used in Heteromera classification, to give an account of their distribution, within and among the heteromeran taxa I have been able to study, and to then compare these to the condition found in the Pterogeniidae. Included will be some new features which have been discovered through the use of the scanning electron microscope, and some functional considerations of these and other more traditional characters used in studies of heteromeran relationships.

List of Taxa

The following annotated list of 58 higher taxa of Heteromera will be referred to in the discussion by means of the abbreviations in square brackets. Although the classification follows that of Crowson (1955; 1966; 1967) and Watt (1967; 1974a; 1974b) for the most part, a number of subfamilial groups are treated separately where family limits are uncertain and intrafamilial variation too great. Any changes in family limits or excluded genera of uncertain affinities are also indicated below. A few groups are left out altogether, especially where larvae are not known. Most genera examined are listed; those with an asterisk are unknown to me as larvae (except for descriptions from the literature), while those with a double asterisk have not been described (or very poorly so) as larvae.

1. Byturidae [BYTU]. *Byturus, Byturellus.*
2. Biphyllidae [BIPH]. *Biphyllus, Anchorius, Goniocoelus.*
3. Mycetophagidae: Mycetophaginae [MYCP]. *Mycetophagus, Litargus, Typhaea.*
4. Mycetophagidae: Bergininae [BERG]. *Berginus.***
5. Tetratomidae: Piseninae [PISN]. *Pisenus.*
6. Tetratomidae: Tetratominae [TETR]. *Tetratoma, Incolia, Eupisenus.* The last genus is normally placed with *Pisenus,* but both larval and adult characters agree with the tetratomines.
7. Tetratomidae: Penthinae [PNTH]. *Penthe.*
8. Melandryidae: Hallomeninae [HALL]. *Hallomenus.* This is usually placed in the Eustrophinae but is isolated here because of its distinctive larva.
9. Melandryidae: Eustrophinae [EUST]. *Eustrophinus, Eustrophopsis.*
10. Melandryidae: Melandryinae [MLDR]. *Melandrya, Zilora, Orchesia,* etc.
11. Melandryidae: Osphyinae [OSPH]. *Osphya.**
12. Mordellidae [MORD]. *Tomoxia, Mordella.*
13. Pterogeniidae [PTER]. *Pterogenius, Histanocerus.*
14. Ciidae: Sphindociinae [SPHN]. *Sphindocis.*
15. Ciidae: Ciinae [CIIN]. *Cis, Xylographus,* etc.
16. Archeocrypticidae [ARCH]. *Enneboeus.* This family was described briefly by Watt (1974b), although the name was originally proposed by Kaszab (1964) on the basis of South American and Oriental forms thought to be tenebrionids. Also included is the North American "tenebrionid" genus *Uloporus* Casey (1889), which may be synonymous with *Enneboeus* Waterhouse. This group is currently being revised by J. C. Watt.
17. Monommidae [MONM]. *Hyporhagus.*
18. Colydiidae: Colydiinae [COLY]. *Aulonium, Namunaria,* etc. This is meant to include most of the tribes not included in the next subfamily. Excluded from consideration are *Myrmechixenus* and the orthocerine group.
19. Colydiidae: Bothriderinae [BOTH]. *Deretaphrus, Bothrideres.*
20. Zopheridae: Ulodinae [ULOD]. *Ulodes.*** Watt (1974b) has removed *Ulodes* and its relatives from the Tenebrionidae.
21. Zopheridae: Usechinae [USEC]. *Usechus.*

22. Zopheridae: Zopherinae [ZOPH]. *Zopherus, Nosoderma, Phellopsis.*
23. Perimylopidae [PERI]. *Hydromedion.* See Watt (1967).
24. Chalcodryidae [CHAL]. *Chalcodrya.** See Watt (1974a).
25. Tenebrionidae: Zolodininae [ZOLO]. *Zolodinus.**
26. Tenebrionidae: Diaperinae [DIAP]. *Diaperis, Eleates, Bolitotherus,* etc. This and the above subfamily are used in the sense of Watt (1974b).
27. Tenebrionidae: Tenebrioninae, etc. [TENB]. This includes the rest of Watt's subfamilies, which are generally consistent with respect to the characters discussed below.
28. Prostomidae [PRST]. *Prostomis* and *Dryocora.** Crowson (1967) added the genus *Paralindria* Olliff (=*Serrotibia* Reitter) and *Cheilopoma* Murray. On the basis of adults only, the former appears to be related to the Trogocryptinae (see below) and the latter may be a tenebrionid.
29. Cephaloidae: Nematoplinae [NEMA]. *Nematoplus.* Mamayev (1973) has recently described the larva from the U.S.S.R. and I have reared the Nearctic species.
30. Cephaloidae: Cephaloinae [CEPH]. *Cephaloon.*
31. Cephaloidae: Stenotrachelinae [STEN]. *Stenotrachelus.**
32. Oedemeridae: Calopodinae [CALO]. *Calopus.*
33. Oedemeridae: Oedemerinae, etc. [OEDM]. *Ditylus, Nacerda,* etc.
34. Pedilidae: Eurygeniinae [EURY]. *Pergetus.* This and the next subfamily are included in a broadly defined Anthicidae by Crowson (1955), but the larvae appear to be of a completely different type. I prefer to retain the old concept of Pedilidae for their inclusion.
35. Pedilidae: Pedilinae [PEDL]. *Pedilus.*
36. Synchroidae [SYNC]. *Synchroa, Mallodrya.* **
37. Mycteridae: Mycterinae & Lacconotinae [MYCT]. *Mycterus, Lacconotus,* etc.
38. Mycteridae: Hemipeplinae [HEMP]. *Hemipeplus.*
39. Boridae [BORI]. *Boros.*
40. Trictenotomidae [TRCT]. *Trictenotoma.**
41. Pythidae [PYTH]. *Pytho, Priognathus,* etc.
42. Pyrochroidae: Ischaliinae [ISCH]. *Ischalia.*** This and the following are aberrant pyrochroids, which may be removed when immature stages are discovered.
43. Pyrochroidae: Lemodinae [LEMO]. *Lemodes.***
44. Pyrochroidae: Pyrochroinae [PYRO]. *Dendroides, Schizotus,* etc.
45. Othniidae: Othniinae [OTHN]. *Elacatis.*
46. Othniidae: Trogocryptinae [TROG]. *Trogocryptus,*** *Holosternus,*** *Anepsicus,*** *Cissocryptus,*** *Eurycratus,*** *Trogocryptoides,*** *Ocholissa,*** *Szekessya,*** *Serrotibia,*** and *Prostominia.* Crowson (1955) placed *Trogocryptus* and its allies, including *Prostominia,* in the Othniidae. Lawrence (1971a) suggested that *Szekessya* might be a prostomid, but further examination has revealed its affinities with the trogocryptines. The placement of this group within the Othniidae is still open to question, and it is possible that they are more closely related to Salpingidae.
47. Salpingidae: Aegialitinae [AEGI]. *Aegialites.* Spilman (1967) removed this genus from the Othniidae, where it was placed by Crowson (1955). Perhaps a better solution would be to unite the Othniidae, Salpingidae, and perhaps Inopeplidae into a family, but this would leave the problem of the transition between this complex and the Pythidae-Pyrochroidae.
48. Salpingidae: Salpinginae [SALP]. This includes the Japanese *Istrisia,* whose larva has some of the characteristics of both Pythidae and Othniidae.
49. Dacoderidae [DACO]. *Dacoderus,*** *Tretothorax.*** These two genera were included in a separate family by Watt (1967), but they appear to be related to salpingids.
50. Inopeplidae [INOP]. *Inopeplus, Diagrypnodes.*
51. Scraptiidae: Anaspidinae [ANAS]. *Anaspis.* This and the next subfamily were considered as derivatives of the Melandryidae by Crowson (1966), but the

larvae appear to have much more in common with the anthicid group, as was indicated by Böving and Craighead (1931).

52. Scraptiidae: Scraptiinae [SCRP]. *Scraptia,* Canifa.*
53. Anthicidae: Macratriinae [MACR]. *Macratria.*** This is included in the Pedilidae in North American works (Arnett 1968), but the adult characters indicate a closer relationship to anthicids.
54. Anthicidae: Anthicinae [ANTH]. *Anthicus, Notoxus,* etc.
55. Anthicidae: Lagrioidinae [LAGD]. *Lagrioida.*** This group was proposed by Abdullah (1968), but the larva, which is apparently known to Crowson, has not been described.
56. Euglenidae [EUGL]. *Elonus,*** *Escalerosia,** unassociated larvae (identified using Hayashi 1972).
57. Rhipiphoridae [RHIP]. *Trigonodera,*** *Rhipiphorus,** etc.
58. Meloidae [MELO]. *Pyrota,** *Nemognatha,** etc. These last two families are highly specialized and not necessarily related. Rhipiphoridae are thought to have evolved from mordellids, and meloids have been associated with cephaloids (Crowson, 1955).

The following alphabetical list of abbreviations may aid the reader in referring back to the taxa discussed above: AEGI: 47. Salpingidae: Aegialitinae; ANAS: 51. Scraptiidae: Anaspidinae; ANTH: 54. Anthicidae: Anthicinae; ARCH: 16. Archeocrypticidae; BERG: 4. Mycetophagidae: Bergininae; BIPH: 2. Biphyllidae; BORI: 39. Boridae; BOTH: 19. Colydiidae: Bothriderinae; BYTU: 1. Byturidae; CALO: 32. Oedemeridae: Calopodinae; CEPH: 30. Cephaloidae: Cephaloinae; CHAL: 24. Chalcodryidae; CIIN: 15. Ciidae: Ciinae; COLY: 18. Colydiidae: Colydiinae: DACO: 49. Dacoderidae; DIAP: 26. Tenebrionidae: Diaperinae; EUGL: 56. Euglenidae; EURY: 34. Pedilidae: Eurygeniinae; EUST: 9. Melandryidae: Eustrophinae; HALL: 8. Melandryidae: Hallomeninae; HEMP: 38. Mycteridae: Hemipeplinae; INOP: 50. Inopeplidae; ISCH: 42. Pyrochroidae: Ischaliinae; LAGD: 55. Anthicidae: Lagrioidinae; LEMO: 43. Pyrochroidae: Lemodinae; MACR: 53. Anthicidae: Macratriinae; MELO: 58. Meloidae; MLDR: 10. Melandryidae: Melandryinae; MONM: 17 Monommidae; MORD: 12. Mordellidae; MYCT: 37. Mycteridae: Mycterinae and Lacconotinae; MYCP: 3. Mycetophagidae: Mycetophaginae; NEMA: 29. Cephaloidae: Nematoplinae; OEDM: 33. Oedemeridae: Oedemerinae etc.; OSPH: 11. Melandryidae: Osphyinae; OTHN: 45. Othniidae: Othniinae; PEDL: 35. Pedilidae: Pedilinae; PERI: 23. Perimylopidae; PISN: 5. Tetratomidae: Piseninae; PNTH: 7. Tetratomidae: Penthinae; PRST: 28. Prostomidae; PTER: 13. Pterogeniidae; PYRO: 44. Pyrochroidae: Pyrochroinae; PYTH: 41. Pythidae; RHIP: 57. Rhipiphoridae; SALP: 48. Salpingidae: Salpinginae; SCRP: 52. Scraptiidae: Scraptiinae; SPHN: 14. Ciidae: Sphindociinae; STEN: 31. Cephaloidae: Stenotrachelinae; SYNC: 36. Synchroidae; TETR: 6. Tetratomidae: Tetratominae; TENB: 27. Tenebrionidae: Tenebrioninae etc.; TRCT: 40. Trictenotomidae; TROG: 46. Othniidae: Trogocryptinae; ULOD: 20. Zopheridae: Ulodinae; USEC: 21. Zopheridae: Usechinae; ZOLO: 25. Tenebrionidae: Zolodininae; ZOPH: 22. Zopheridae: Zopherinae.

Adult Characters

Among adult characters used in heteromera classification, the frontoclypeal suture has a somewhat erratic distribution, and in some groups its occurrence is quite variable. Its presence appears to be primitive in the Heteromera, although it is lacking in Biphyllidae and Byturidae. Those taxa in which the frontoclypeal suture occurs include MYCP, BERG, PISN, TETR, PNTH, HALL, EUST, OSPH, PTER, SPHN, CIIN, ARCH, PERI, CHAL, DIAP, TENB, PRST, ISCH, LEMO, INOP, ANAS, SCRP, ANTH, LAGD, EUGL, and MELO. In chalcodryids and tenebrionids, however, the condition is variable, and the same is true for inopeplids and the scraptiid-anthicid group.

The concealment of the antennal insertions is another variable character in many Heteromera, and it may be associated with the degree of substrate locomotion practiced by the adult. The insertions are always concealed in SPHN, CIIN, ARCH, MONM, COLY, USEC, ZOPH, ZOLO, DIAP, TENB, and DACO. The condition in Pterogeniidae is variable, and the lack of antennal ridges in *Histanocerus* is probably connected with the need to move the enlarged first antennal segment. The degree of concealment also varies in BIPH, MYCP, SYNC, PYTH, and TROG. Slight concealment occurs in PISN and BORI.

The terminal segment of the maxillary palps in many Heteromera may be spindle-shaped or cylindrical, although usually truncate at the apex. In a number of taxa, and especially in those which are active on surfaces, the apex is distinctly enlarged and securiform or cultriform. This condition occurs in MLDR, OSPH, MORD, PTER, ARCH, CHAL, NEMA, CEPH, STEN, CALO, OEDM, EURY, PEDL, SYNC, MYCT, HEMP, TRCT, PYTH, ISCH, LEMO, PYRO, ANAS, SCRP, MACR, ANTH, LAGD, and EUGL. In some of these (NEMA, OEDM), the apical expansion is only slight.

The degree of development of the coxal cowling formed by the prosternal and pronotal projections has always been a major classificatory character in beetles, and it is usually expressed by the terms "open" and "closed" coxal cavities. Four conditions are possible (although they obviously grade into one another): internally and externally open cavities, those internally open and externally closed, those internally closed and externally open, and those internally and externally closed. The first condition (int. open/ext. open) always occurs in BERG, TETR, PNTH, OSPH, SPHN, MONM, USEC, ZOLO, CEPH, STEN, BORI, TRCT, ISCH, PYRO, EUGL, and MELO. In CIIN, the int. open/ext. open condition is predominant but not universal, in BOTH it occurs in some forms, in PEDL it occurs in all but some Australian ictistygnines (which have an external closure), in PYTH only the genus *Sphalma* has a narrow internal closure, and in SALP the int. open/ext. open condition occurs only in *Istrisia*. The second condition (int. open/ext. closed) is found in COLY, BOTH, ULOD, ZOPH, and PERI. The int. closed/ext. open condition is characteristic of MYCP, PISN, HALL, EUST, MLDR, MORD, PTER, NEMA, CALO, OEDM, EURY, SYNC, MYCT, HEMP, LEMO, TROG, AEGI, SALP, DACO, INOP, ANAS, SCRP, MACR, ANTH, LAGD, and RHIP, as well as *Sphalma*. Finally, the double closure (internal and external) occurs in BYTU, BIPH, ARCH, CHAL, DIAP, TENB, PRST, and OTHN. The primitive condition of the procoxal cavities is difficult to ascertain. Among those Languriidae which Sen Gupta and Crowson (1971) have proposed as possible ancestors of the Heteromera, the Xenoscelinae (=Loberinae) have the int. open/ext. open condition, with an external closure in one genus, the int. closed/ext. open condition occurs in Toraminae and Setariolinae, and a double closure occurs in the Cryptophilinae. Within the Heteromera, double closure occurs in biphyllids and byturids, but the int. open/ext. open and int. closed/ext. open conditions also occur in undoubtedly primitive forms.

Two other characters closely associated with the above are the form and extent of the prosternal intercoxal process, which separates the procoxae externally, and the portion of the procoxa which is concealed by the lateral part of the coxal cowling. The intercoxal process may be broad to very narrow or laminate, or it may be reduced and not extend very far posteriorly between the coxae; the apex may be strongly expanded and joined to the postcoxal process of the hypomera, slightly expanded, truncate, or acute. Strongly expanded apices occur in ARCH, COLY, BOTH, ULOD, USEC, ZOPH, PERI, CHAL, OTHN, TROG, and AEGI, and are associated with externally closed or narrowly open cavities. Another distinctive condition is the extremely narrow and often shortened intercoxal process, which may be absent altogether in some forms. This occurs in surface-dwelling forms with conical, subcontiguous procoxae, such as EUST, MLDR, OSPH, MORD, NEMA, CEPH, STEN, CALO, OEDM, EURY, PEDL, MYCT, PYTH, ISCH, LEMO, PYRO, SALP, ANAS, SCRP, MACR, ANTH, EUGL, RHIP, and MELO.

The prothoracic pleurocoxal mechanism has been discussed in detail by Hlavac (1972; 1975). Heteromera, for the most part, have a specialized, reduced type of pleurocoxal mechanism, and in many cases the trochantin and much of the procoxa is enclosed by the coxal cowling. In an extreme case, the internalized portion of the procoxa is more than half as long as or even longer than the visible portion. This type occurs in MONM, COLY, BOTH, ULOD, USEC, ZOPH, ZOLO, DIAP, TENB, PRST, TROG, AEGI, SALP, DACO, and INOP. Other forms with more than a slight internalization of the procoxa include MLDR, PERI, CALO, OEDM, EURY, PEDL, SYNC, MYCT, HEMP, BORI, PYTH (*Sphalma*), EUGL, and LAGD. Most of the primitive Heteromera, including the pterogeniids, have no internalized portion at all.

The lateral closure of the mesocoxal cavities by the meso- and metathoracic sterna (closed cavities), as opposed to their closure by the mesepimera (open cavities), represents a dichotomy often used in heteromeran keys. The closure by the sterna is always associated with a hidden mesotrochantin, but in the eustrophine melandryids the trochantin is concealed although the mesocoxal cavities are "open." Open cavities are apparently primitive, and closure by the sterna has occurred a number of times in MYCP (*Typhaea*), BERG, MONM, COLY, BOTH, ULOD, USEC, ZOPH, some TENB, MYCT, HEMP, OTHN, TROG, AEGI, SALP, DACO, and INOP. The interlocking mechanism between the mesosternum and metasternum at the midline might be a useful new character in heteromeran classification, but I have not taken the time to analyze it properly. A number of forms, including the Pterogeniidae, have a process on one of the sterna which fits into a notch on the other, but some forms have double notches, while in others the two sterna appear to lack any interlocking structures.

The fusion of basal abdominal sternites is an extremely variable condition and one which is difficult to determine for various reasons. In some heavily sclerotized forms, the segments may be united by membranes which are concealed by cuticular abutments (*see* Watt 1967: 117). In lightly sclerotized forms, on the other hand, it may be difficult to distinguish connate segments from "free" ones (*see* Lawrence, 1971b: 4-5). Often, the first two visible sternites (3 and 4) are fused and immovable (although with a distinct suture), the joint between the second and third (4-5) is less flexible, and that between the posterior segments is completely flexible. Sternites 3 and 4 are definitely connate in PNTH, some MLDR, PTER, SPHN, ARCH, PRST, STEN, CALO, SYNC, TRCT, some PYTH (*Sphalma*), ISCH, some TROG, AEGI, some SALP, LAGD, and EUGL, and in some of these (PNTH, CALO, TRCT, TROG) sternite 5 may be partially fused to 4. In *Elacatis* (OTHN) the basal sternites may be connate, but the entire abdomen is lightly sclerotized. Sternites 3 through 5 are connate in MONM, COLY, BOTH, ULOD, USEC, ZOPH, PERI, CHAL, ZOLO, DIAP, TENB, MYCT, HEMP, and BORI; in MONM, COLY, BOTH, USEC, and CHAL, sternite 6 may also be fused to 5. In DACO the sternites appear to be fused externally in dry specimens, but there is concealed membrane between each of the pairs of segments. In only two groups (AEGI and EUGL) is the suture between 3 and 4 lost entirely.

Wing venation in the Heteromera exhibits relatively little variation, the main characters involving the radial cell and Radial Sector, subcubital fleck, wedge cell, and number of veins between the Cubitus and jugal area (anal veins according to Crowson, but including the posterior branch of the Cubitus according to Ponomarenko 1973). The radial cell, wedge cell, and anal veins drop out readily in small forms, but the subcubital fleck remains in some of the smallest species, even in some Ciidae with reduced wings. An entire subcubital fleck occurs in MYCP, BERG, PISN, TETR, EUST, OSPH, SPHN, ARCH, COLY, ULOD, CHAL, ZOLO, some TENB, PRST, CALO, EURY, PEDL, SYNC, MYCT, BORI, PYTH, OTHN, TROG, SALP, MACR, LAGD, and EUGL. In a few taxa (BYTU, PTER, and LEMO) the fleck is divided by the posterior branch of the Cubitus, while in CIIN, which lack this vein, the fleck is very close to the main branch of the Cubitus and is also divided into two parts by what may be a remnant of the posterior branch.

The metendosternite does not appear to be particularly useful in determining heteromeran relationships. The stalk is usually relatively long, the laminae moderately well-developed, and the anterior tendons out on the arms. Pterogeniidae have the stalk narrow and the laminae very reduced, as do *Sphindocis* and the tenebrionid group. Female genitalia have been studied by Watt (1974a; 1974b) for certain heteromeran groups, but I have insufficient comparative data at present to pursue this character complex.

The male genitalia have been examined for all of the taxa listed above, but a proper analysis of these structures is beyond the scope of this paper. Among the forms studied there is a great deal of variation, and homologies are often difficult to ascertain. According to Crowson (1955: 114), the heteromeran aedeagus evolved from a primitive cucujoid type (ring-shaped tegmen bearing a ventral, basally projecting process and dorsal, articulated, distally projecting parameres) by the loss of the ventral portion of the ring, leaving the entire tegmen dorsad of the median lobe. Within the Heteromera, the Biphyllidae and Byturidae have the most clavicorn-like aedeagus, in that the tegmen does encircle the median lobe and does bear a median, basoventral process; the parameres, however, are fused to the apex of the tegmen. The typical heteromeran aedeagus consists of a dorsal, trough-like tegmen, which may or may not be divided into an apical and basal portion, and a ventral median lobe, partially enclosed by the sides of the tegmen. In a number of groups, however, the tegmen is ventral to the median lobe; this is thought to be the result of a torsion of the external genitalia. Determining the position of the tegmen is often difficult, since it must be examined while still within the abdomen and also while extruded; in some forms it appears to lie in a lateral position within the abdomen. The tegmen may consist of a single piece, or it may include a basal piece and one or two apical parameres. In addition, there may be lateral struts which partly encircle the median lobe or accessory processes, which are usually articulated and attached to the single paramere. In *Pisenus*, the basal piece is sclerotized ventrally, but at its apex, it extends dorsally and bears a pair of articulated parameres; in addition, the basal piece bears a pair of ventral, articulated, subapical accessory lobes. The situation is further complicated in some groups by the addition of modified pregenital sclerites.

The few generalizations which will be made at this time concern the position of the tegmen (unknown in several groups) and the occurrence of accessory lobes on the paramere. The dorsal or "normal" orientation of the tegmen occurs in MYCP, TETR, PNTH, EUST, MLDR, ARCH, PERI, CHAL, DIAP, most TENB, EURY, PYTH, PYRO, OTHN?, TROG, AEGI, SALP, DACO, INOP, ANAS, SCRP, MACR, ANTH, and MELO. The ventral or "inverted" type occurs in PISN, MORD, PTER, SPHN, CIIN, MONM, COLY, ULOD, USEC, ZOPH, ZOLO, some TENB, PRST, NEMA, CEPH, STEN, CALO, OEDM, PEDL, SYNC, MYCT, HEMP, TRCT, ISCH, EUGL, and RHIP. The condition in some of these groups may be variable, as it is in the Tenebrionidae. Accessory lobes of a particular type, which are narrow and attached near the base of the single paramere, occur in BORI, TRCT, most PYTH, TROG, most SALP, DACO, and INOP. This has been used as evidence for uniting the salpingids and pythids, but it is obvious that more groups are involved (*see* Spilman 1952; 1967). The pterogeniid aedeagus is of the inverted type, with a large basal piece and single (though deeply emarginate) paramere; the tegmen resembles that of the colydiid *Aulonium*, but the complex median lobe is unique among the forms examined.

Larval Characters

Larval characters in the Heteromera have been even less precisely defined than those of the adult. The frontoclypeal suture in the larva is almost always absent, but it appears to be at least vaguely indicated in MLDR, ARCH, ZOPH, CALO, and the tenebrionids. The clypeal area may be considered to begin at a line drawn between the dorsal mandibular articulations. In some larvae, the apex of the clypeus is unpigmented, and the line where the pigment ends may be mistaken for the frontoclypeal suture.

The coronal and frontal sutures (epicranial suture) have been demonstrated to be ecdysial lines (Snodgrass 1960), and they are not usually associated with internal ridges (but see below). In the preceding descriptions, I have used epicranial stem for the basal portion of the line and frontal arms for the anterolateral branches. In most Heteromera, the frontal arms are lyriform and the epicranial stem is short or absent, but relatively long stems with lyriform arms occur in PISN, HALL, some EUST (*see* Hayashi 1975), PTER, CALO, SYNC, SCRP, and ANTH; the stem in pterogeniids is further distinguished by being bent to the left. Some Heteromera have straight V-shaped frontal arms, usually associated with a long stem (most MLDR, SPHN, CIIN, some ZOPH, CHAL, ZOLO, DIAP, most TENB, NEMA, CEPH, OEDM and MELO). In a few groups (PTER, CHAL, ANAS), the two frontal arms are joined anteriorly by a transverse ecdysial line.

The head capsule may bear, in addition, one or two internal ridges, which have been called endocarinae. The term has usually been restricted to a median internal ridge which extends anteriorly from the epicranial stem, but here it will include those which coincide with the stem and sometimes extend onto the bases of the frontal arms (sutural), those median carinae which extend anterad of the stem (anterior), and those which lie laterad of the epicranial stem and/or frontal arms (lateral). A single sutural endocarina occurs in MORD, CIIN, ZOPH, DIAP, NEMA, CEPH, CALO, OEDM, and SYNC, while two sutural endocarinae occur in those forms without or with a very short stem (MLDR, OSPH?, EURY, PEDL, OTHN, TROG, AEGI, SALP, INOP). Lateral endocarinae are restricted to the Monommidae, while the anterior type occurs in some EUST, HEMP, SCRP, and ANTH.

The ventral part of the mouth cavity just above the labiomaxillary complex is strengthened by sclerotized hypostomal redges, which may continue posteriorly as hypostomal rods. These rods are usually divergent or subparallel and occur in many groups of Heteromera. They are absent in PNTH, MORD, SPHN, CIIN, ZOPH, PERI, CHAL, ZOLO, DIAP, TENB, NEMA, CEPH, OEDM, EURY, PEDL, SYNC, PYTH, AEGI, and SCRP, but may be quite short in some other groups. A second pair of ridges may extend posteriorly from the ventral mandibular articulations and lend further support to the ventral mouthparts; these structures, which have been called ventral epicranial ridges by Glen (1950), are common in Elateriformia, but occur within the Heteromera only in Ciidae and some Biphyllidae.

The malar apex of the maxilla is often used to compare heteromerous larvae, but the terminology is sometimes confusing. The word "uncus" has been used for a variety of structures at the inner apical angle, but it is sometimes restricted to a distinct lobe, such as that in *Anaspis*. The inner angle in many Heteromera bears one to several teeth, and this is called the uncus by Watt (1974a; 1974b) and Hayashi (1969; 1972). This type of uncus occurs in BYTU, BIPH, PTER, ARCH, MONM, COLY, USEC, ZOPH, PERI, PRST, NEMA, STEN?, CALO, OEDM, EURY, PEDL, SYNC, MYCT, BORI, PYTH, PYRO, OTHN, TROG, SALP, and INOP. The apex of the mala may also be cleft, so that it is partly divided into as inner and outer section; this cleft is usually associated with a sclerotized area and occurs in MONM, COLY, USEC, ZOPH, PERI, STEN?, CALO, OEDM, EURY, PEDL, SYNC, MYCT, HEMP, BORI, PYTH, PYRO, OTHN, TROG, and ANAS. In PRST, NEMA, and CEPH, there is a broad, shallow gap at the malar apex, which is not associated with a sclerotized area, and this may also be the case in TRCT (if the stylized drawing of Gahan, 1908, is to be belived). In PTER, there is a distinctive, bifurcate uncus near the inner angle (*see* Fig. 25); also unique are the dorsal, laciniar lobe in SPHN and CIIN, the dorsal brush of TETR and EUST, and the previously mentioned uncus of ANAS.

Recent studies with the scanning electron microscope have helped clarify the structure of the larval mandible and have revealed certain types of microsculpture previously overlooked. The mandibular prostheca, common throughout the Clavicornia, is absent in almost all heteromerans. The term has been applied to a variety of structures, arising from the area lying between the apical teeth and the mola, most of which are hyaline or unpigmented and often flexible or membranous as well. Within the Heteromera, the Biphyllidae have a complex prostheca consisting of comb-like processes, while some byturids have vestiges of this. In the Ciidae, the mola is absent, and there is a small hyaline tooth in the molar area; this was called "retinaculum" by Lawrence (1971a; 1974) but has no relationship to the retinaculum in Adephaga or Elateridae. This type of hyaline tooth or several such teeth turn up in other heteromerans which have lost the molar part (MONM, BOTH, AEGI, some SALP, some INOP) and may be remnants of molar teeth.

In some primitive heteromerans (BIPH, MYCP, HALL, COLY), the molar region of the mandible is tuberculate, and the tubercles tend to be placed in transverse rows (perpendicular to the long axis of the mandible) and extend onto the ventral surface as well. The tubercles may also coalesce laterally, forming transverse ridges, alternating with deep troughs. In PISN, PTER, and ARCH, the entire surface appears to have been reinforced by the coalition of these tubercles, so that it consists of transverse ridges alternating with rows of small, deep pits (Figs. 16-23). Except for the biphyllids, these mandibles are somewhat asymmetrical with the right mola more oblique than the left, and in the pterogeniids the asymmetry is extreme. Large, asymmetrical mandibles with a molar surface consisting of fine transverse ridges, alternating with deep troughs, may be found in a number of derived heteromerans, such as SYNC, BORI, PYTH, PYRO, and OTHN, while in others (DIAP, PRST, NEMA, CEPH, CALO, and OEDM) the ridges are shallower and show no signs of a previous tuberculate condition. Within this latter group are forms with distinctly asymmetrical head capsules (DIAP, PRST, NEMA, OEDM; *see* Mamayev 1973). Mandibles with transverse ridges on the mola also occur in STEN, PEDL, some MYCT, HEMP, TRCT, TROG, some SALP, and some INOP, but the details of these have not been examined with the S.E.M. Two other major trends involve the gradual reduction of the mola in some lines and in others the formation of two concave molar areas which act in conjunction with a hypopharyngeal sclerome (*see* below) to compact food masses. Molar reduction is often thought to occur in association with predaceous habits, but it is just as likely to occur in those species which feed on particularly hard substrates. Molar reduction can be seen in BYTU, TETR, PNTH, EUST, MLDR, OSPH, MORD, SPHN, CIIN, MONM, some COLY, BOTH, PERI, AEGI, some SALP, some INOP, ANAS, SCRP, ANTH, EUGL, RHIP, and MELO. Following the details of these developments is beyond the scope of the present paper. A concave molar area occurs in ZOPH, CHAL, ZOLO, most TENB, EURY (with a few ridges), and some MYCT.

The hypopharyngeal sclerome usually refers to a distinctly sclerotized structure just behind the pypopharynx proper and attached to the mesal portion of the hypopharyngeal bracon (*see* Fig. 8). The structure is often mola-like, but is may consist of a sclerotized bar only, and it is often associated with various setal brushes. The mesal area of the bracon and the base of the mentum are often reinforced by a sclerotized ring, but I have restricted the word sclerome to a sclerotized area on the floor of the mouth behind the hypopharynx. This structure may function in connection with ventral mandibular tubercles to cut food particles, or it may act in conjunction with the concave molar areas to compact food masses. A hypopharyngeal sclerome of some kind almost invariably occurs wherever the mola is developed, and it is lost in groups such as tetratomids, melandryids, ciids, monommids, and those salpingids and inopeplids which have undergone extreme molar reduction.

Scanning electron microscope studies have been particularly helpful in clarifying the structure and possible function of the dorsal mandibular armature. Shiny patches or vague lines on the basomesal portion of the dorsal mandibular surface may be seen with light microscopy, and such areas have been described by Hayashi (1975: 165) for *Synchroa*. As seen in Figs. 18-19 and 22-23, these areas contain fine, cuticular elements, usually flattened, which are inclined and which face in a basomesal direction; they may be packed in groups of three or four and form oblique rows extending from basolateral to apicomesal. These structures occur in a variety of Coleoptera (primitive staphylinoids, primitive dermestoids, many Cucujoidea) and apparently act in conjunction with fringed pharyngeal plates (Fig. 24) to move small particles into the mouth cavity (or conversely to keep these particles away from the membranes at the bases of the mandibles). Further studies on the structure of these and other parts of the larval feeding mechanism are nearing completion and will be published elsewhere. Dorsal mandibular armature has been observed in BIPH, MYCP, PISN, PTER, ARCH, COLY, PRST, NEMA, CEPH, CALO, OEDM, EURY, PEDL, SYNC, BORI, PYTH, PYRO, OTHN, TROG, some SALP, and some INOP, but the cuticular elements in PRST are restricted to a small area, while those of NEMA and CEPH are, in addition, more randomly arranged and not in distinct rows.

Characters involving the labium, maxillary base, and labiomaxillary articulating area have been used to a limited extent in Heteromera. The maxillary articulating area is usually well-developed, although reduced in Ciidae, and it may be divided into two distinct parts in certain groups, such as ZOPH, SYNC, and CEPH. Special attention has been given to the division of the cardo, but this has been misused by some authors. In many cases, the cardo is partly divided internally by a ridge, whereas in the Mycteridae there may be two distinct pigmented areas but no internal division; in neither case can the cardo be said to be divided. These and other labial and maxillary characters may be of use in determining relationships among the Heteromera, but not until the various conditions are more clearly defined.

Spiracular characters have also been limited to one or two simple dichotomies, but Watt (1974b) has recently shown spiracular details to be useful in clarifying subfamilial relationships within the Tenebrionidae. Many species of Heteromera have annular-biforous spiracles, although in some the accessory chambers are much smaller than the peritreme. Annular spiracles occur in OSPH, MORD, CIIN, BOTH, ZOPH, PERI, CHAL, ZOLO, DIAP, TENB, NEMA, CEPH, CALO, OEDM, EURY, SYNC, MYCT, BORI, TRCT, PYTH, PYRO, AEGI, INOP, SCRP, ANTH, EUGL, RHIP, and MELO, but in most of these cases, the condition is obviously derived from the annular-biforous type.

The abdominal apex (segments 9 and 10) exhibits considerable variation among the Heteromera and may prove useful in phylogenetic studies. The 10th segment is typically somewhat transverse, more or less membranous, and postero-ventrally oriented, but it ranges from being almost cylindrical and posterior (BYTU, BIPH, NEMA) to strongly transverse with distinct, lunate tergum and sternum (MYCO, ARCH, SCRP, EUGL), reduced and ventrally oriented (MYCT, BORI, PYTH, PYRO, SALP, etc.), or almost concealed by 9th segment, except for protruding pseudopods (ZOLO, TENB). The tergum of segment nine usually bears a pair of solid urogomphi, but these may be reduced or lost in various groups (MLDR, MORD, CIIN, CHAL, DIAP, TENB, NEMA, OEDM, etc.). In the pythid-salpingid group, the ninth tergum extends well onto the ventral surface, and may be divided into several plates, while in the Mycteridae and Boridae, it forms a hinged structure which articulates with segment 8 (and the enclosed 9th sternite and 10th segment). The ninth sternum often bears two or more teeth or asperities, which have been used as key characters. A single pair of basal asperities may be found in the larvae of HALL, PEDL, SYNC, TROG, AEGI, and most SALP. The number of basal asperities on each side is from 2 to 6 in INOP, 4 in CALO, 6? in TRCT, about 10 in OTHN and *Istrisia*, and about 14 in PYTH and PYRO. In a few taxa, asperities occur at the apex of the ninth sternum: a pair of fairly large teeth near the midline in EURY, and about 40 very small asperities along the apical edge in SPHN, COLY, and PRST.

Phylogenetic Relationships

The preceding is essentially a presentation of raw data, taken from direct observation, except in a very few cases where larvae were unavailable for study. I have not attempted to determine the plesiomorphic and apomorphic condition of each character state, since in most cases such a dichotomy does not exist, at least at this rather crude stage of analysis. Perhaps as the morphological characters are more precisely defined, a greater number of truly synapomorphic conditions may be discovered. Works, such as those of Abdullah (1973; 1974) do little to clarify the situation, since the dichotomies presented are arbitrary and oversimplified, if not irrelevant, and much of the information appears to be taken from the literature.

Given the data presented above, however, it ought to be possible to recognize some clusters within the Heteromera, which might eventually form the basis for a new classification. The most recent heteromeran phylogeny was proposed rather tentatively by Crowson (1966). Not commenting on the relationships of the Byturidae, Biphyllidae, Prostomidae, or Oedmeridae, Crowson suggested a heteromeran ancestral type similar to the Tetratomidae, giving rise initially to mycetophagids, tetratomids, ciids, and pterogeniids (the last two represented as sister groups). He then proposed a more advanced ancestral type with zopherid-like larvae and synchroid-like adults, which would give rise to four main lines: Synchroidae- Cephaloidae- Zopheridae- Monommidae- Colydiidae- Tenebrionidae; Melandryidae- Mordellidae- Scraptiidae- Rhipiphoridae; Pythidae- Pyrochroidae- Salpingidae- Mycteridae- Inopeplidae- Othniidae; and Anthicidae- Euglenidae- Meloidae. There appears to be strong evidence supporting the pythid-salpingid group in the aedeagus, larval mandible, and larval abdominal apex. Crowson's Anthicidae is used in the broad sense to include eurygeniines and pedilines, which are probably better placed near the Pyrochroidae. Also the Scraptiidae appear to be more closely related to the anthicid-euglenid group (in the narrower sense); this is quite evident in the larvae, and is consistent with adult structure, if the wedge-like body form is considered to be a protective adaptation independently arrived at in mordellids. New larval descriptions of Tetratomidae and Melandryidae by Hayashi (1972; 1975) and Viedma (1966; 1971) have tended to blur the distinctions between Tetratominae and Eustrophinae, as well as between the Piseninae and Mycetophagidae, while emphasizing the isolated position of *Hallomenus* and *Mycetoma*, and that of the more advanced melandryines and osphyines. Crowson's synchroid-cephaloid-zopherid group seems consistent with larval characters, although the adults have diverged greatly in structure, representing two different life cycle strategies. The Tenebrionidae may well be derived from this group, and there are indications that both Oedemeridae and Prostomidae might belong here as well. The relationship between monommids and colydiids appears to be well grounded on both larval and adult characters, but it is easier to relate the two of them to archeocrypticids, mycetophagids and pisenines, than to the Tenebrionidae. Perhaps some of the similarities between colydiids and tenebrionids involve colydiid genera that are misplaced to begin with (tenebrionids or zopherids with reduced numbers of tarsal segments). The answer to this and other questions may be answered by J. C. Watt, who is completing his studies on the Zopheridae and on the phylogeny of the Heteromera as a whole.

The phylogenetic relationships of the Pterogeniidae are to be sought among the primitive Heteromera, as suggested by Crowson (1966) and Lawrence (1971a; 1974), while possible sister groups include the Piseninae, Ciidae, and Archeocrypticidae, all three of which share with the pterogeniids such characters as the lack of an internal extension on the procoxa, presence of a frontoclypeal suture in the adult, and subcubital fleck on the wing. The Ciidae are similar to pterogeniids in having an inverted aedeagus, divided subcubital fleck (Ciinae only), and characteristic larval antenna with a narrowly conical and very long sensory appendix. Also, the subapical lobe formed by the displacement of inner malar spines in the larva of pterogeniids could be homologous to the laciniar lobe in Ciidae. The ciid mala, however, is rounded, not truncate, and lacks an uncus, and the laciniar lobe is much more basal in position, being at the level of the palpifer. Ciid adults differ in having internally open procoxal cavities and lacking the securiform apex on the larval maxillary palp, and the larvae have V-shaped frontal arms and no mandibular mola.

The mandibular mola in larval Pterogeniidae is of a highly specialized, grinding type, but it is easily derived from that of either Archeocrypticidae or Piseninae (with transverse ridges alternating with deep pits). These, in turn, are derivable from a simpler, tuberculate type, such as that of Mycetophagidae. Pisenine adults resemble those of Pterogeniidae in having internally closed procoxal cavities and an inverted aedeagus (but of a unique type), and the larva is similar in general form and antennal structure. The subcubital fleck, however, is not divided, and the larval mala is short and rounded without an uncus.

Adult Archeocrypticidae have securiform maxillary palps, but have a double closure of the procoxal cavities, a dorsally oriented aedeagus, and an undivided subcubital fleck. Archeocrypticid larvae differ from pterogeniids and resemble Mycetophagidae in the slightly flattened form with a transverse, posteriorly oriented 10th segment; the larval mala, on the other hand, is truncate and at the inner angle bears a bifurcate uncus which appears to be homologous with the laterally displaced uncus of Pterogeniidae.

The larval and adult biology of pterogeniids (feeding in bracket fungi) is similar to that of both ciids and tetratomids, whereas the Archeocrypticidae (at least several New World *Enneboeus*) inhabit leaf litter and feed on rotten flowers and probably other types of decaying plant material. The ciids, in particular, have evolved the habit of boring into relatively hard and durable fruiting bodies—the same species that are utilized by pterogeniids—and yet they have evolved a very different mandibular type (lacking a mola) and malar apex (round with a laciniar lobe and no uncus). Archeocrypticids, with a different type of biology, have a similar, but less modified type of mandible and a similar malar apex.

The evidence is certainly not conclusive, but it suggests that Archeocrypticidae and Pterogeniidae are closely related families, and that both have affinities to Ciidae, Tetratomidae, and Mycetophagidae.

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THE LIFE HISTORY OF *SERROPALPUS COXALIS,* WITH A DESCRIPTION OF THE LARVA AND PUPA (COLEOPTERA: MELANDRYIDAE)

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Abstract

Larvae and pupae of *Serropalpus coxalis* Mank were found in the sound wood of a felled hemlock, *Tsuga canadensis* (Pinaceae). The larvae excavate tunnels in the wood. Pupation occurs in cells in the wood close to the surface. An ichneumonid, *Odontocolon canadense* [Hymenoptera: Ichneumonidae: Xoridinae], is a parasite of larvae. Host records of 2 other species of *Serropalpus, S. barbatus* and *S. substriatus,* are listed. Larval and pupal stages of *S. coxalis* are described and illustrated.

The literature on the bionomics of the immature stages of the Melandryidae is scant. The habits of those species that are known are varied; some are found in dry, seasoned wood, some under bark, some in decayed logs usually associated with wood-decaying fungi, some in dry shelf fungi, and some in tree stumps (Peterson 1951, Blatchley 1910).

The major groups comprising the Melandryidae (*sensu* Arnett 1968) are more or less ecologically defineable. The adults of the Tetratominae[1], with only few exceptions, are small, oval, convex forms that live in dry woody fungi and beneath the bark or in the rotton wood of fungus-covered logs (Blatchley 1910). The larvae are usually found in the same habitats. Adult and larval habits and a number of fungus habitats of several British tetratomid species have been discussed in some detail by Crowson (1963) and Paviour-Smith (1964). Hayashi (1972) recorded larval habitats for several tetratomid species occurring in Japan. The Melandryinae include members whose larvae are found either under the bark of deciduous trees, or boring in sound timber. In the Scraptiinae[2], the larvae of some species have been taken in decayed forest litter (Peterson 1951), or in rotton wood and fungi. Adults of species of *Osphya,* the only genus comprising the Osphyinae, have been found frequenting foliage and flowers, especially of *Crataegus* (Blatchley 1910). Larvae of some European species of *Osphya* occur in the dead wood and under the bark of various deciduous trees, and in rotting tree stumps (Viedma 1965). The habits and ecology of the Anaspidinae[3] are not well known. The larvae of *Anaspis* occur under loose bark and in crevices of decaying wood (Crowson 1955).

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[1] Crowson (1955) considers this subfamily to be a separate family, the Tetratomidae, as do many other authors.

[2] Crowson (1955) separates the Scraptiinae from the Melandryidae and forms the family Scraptiidae.

[3] Crowson (1955) includes the Mordellidae-Anaspidini in the family Scraptiidae. Arnett (1968) includes the Anaspidini as a subfamily of the Melandryidae.

Mank (1939) made a review of the genus *Serropalpus* and concluded that the North American fauna includes 3 species, *S. substriatus* Haldeman, *S. obsoletus* Haldeman, and *S. coxalis* Mank. In an earlier treatment of the genus by Seidlitz (1898), 3 species were regarded as distinct in America, namely *S. barbatus* Schaller, *S. substriatus,* and *S. obsoletus.* Mank has shown that *barbatus* does not occur in North America; specimens called *S. barbatus* from North America should (probably) be called *S. substriatus.*

LIFE HISTORY AND HABITS

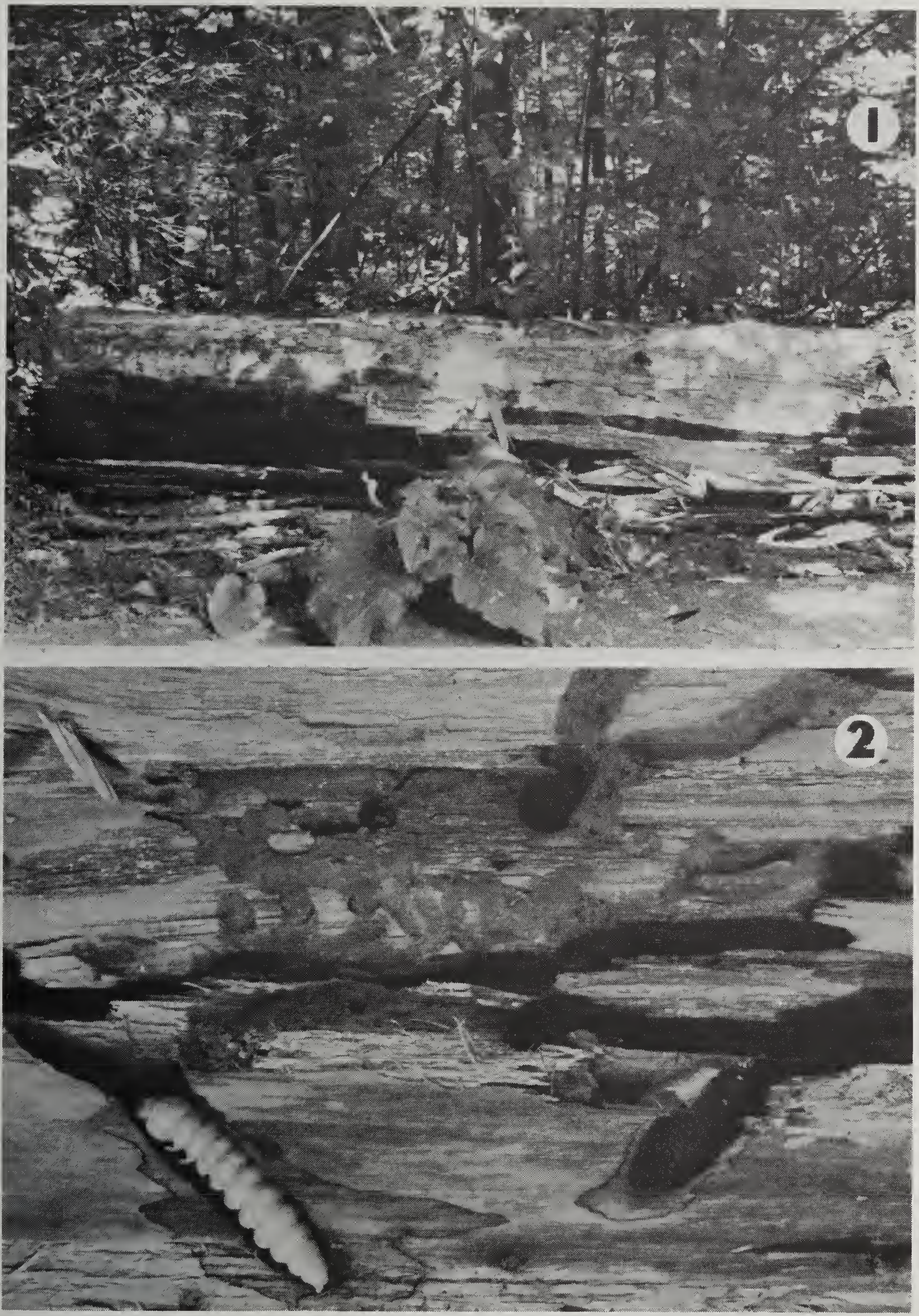
Serropalpus coxalis larvae were found tunneling in the sound wood of a felled hemlock, *Tsuga canadensis* (L.) Carr, on the Cornell University campus in Ithaca, New York (Tompkins County) (Fig. 1). The tunnels were relatively shallow, with a maximum depth of about 3 cm below the surface. The tree in which the larvae were found was believed to have been cut down 2 years earlier, and the infested wood was very dry and solid with no signs of dead rot. The log was 3 meters long and 0.5 meter in diameter. Over 200 adult specimens were removed from this log. As the beetle is a northern species that has been recorded from Alaska to New Jersey (Mank 1939), presumably conifers other than hemlock are attacked because the tree does not occur throughout the beetle's range.

The larvae usually bore parallel to the surface at 0.8 cm below the wood-bark interface (Fig. 2). Pupae were frequently found at this depth, and the emerging adults have to gnaw through the wood and bark to reach the surface.

Adult beetles were collected from the hemlock log on 9 June and 13 June, 1975, and larvae and pupae were taken on 14 June, 1975. Intermittent observations were made during the first few weeks of June, until the activity and numbers of the adults subsided (25 June, 1975). During the daylight hours, the beetles were quiescent and refused to fly and would run or drop when disturbed; they appeared to become active at twilight. During the early evening, copulating pairs were occasionally found on the surface of the bark. The capture of specimens attracted to "black light" at Ithaca and other localities in Tompkins County confirms the crepuscular and nocturnal habits of the beetles.

Mank (1939), from the specimens she examined when she first described the species, found the size of the adults to range from 6.0-13.0 mm. Measurements were made from 199 specimens that we collected, and the range in size was found to be 4.8-14.4 mm, with a mean length of 10.8 mm. The length was measured from the anterior margin of the head to the apex of the elytra. The females average larger than the males. Females ranged in size from 4.8-14.4 mm (mean 11.01 mm, n=90), males from 4.8-13.6 mm (mean 9.84 mm, n=109).

Other species of *Serropalpus* are similar in host preferences. All known larval host plants are coniferous. Norway spruce, *Picea abies,* is recorded in the literature as a host of the European *Serropalpus barbatus* (Viedma 1965). Bletchley (1955) also listed silver fir (*Abies alba*) and an unidentified species of fir as hosts of *S. barbatus.* All other records are associated with *Serropalpus substriatus* and western North America. Specimens of *S. substriatus* in the Cornell University collection were found with the following host information: subalpine fir, *Abies lasiocarpa*; engelmann spruce, *Picea engelmannii*; lodgepole pine, *Pinus contorta*; western white pine, *Pinus monticola*; and ponderosa pine, *Pinus ponderosa*.



Figs. 1-2, Habitat of *Serropalpus coxalis*: 1, Trunk of host tree, *Tsuga canadensis*; 2, Mature larva of *S. coxalis* and larval mines in hemlock.

Male and female parasites, identified as the xoridine ichneumonid, *Odontocolon canadense* (Provancher), were apparently parasitizing the larvae of *S. coxalis.* Many male parasites were observed frequenting the hemlock log, but female parasites were rare and only one was collected. The parasites were first collected on 21 May, 1975. They were abundant on 14 June, 1975, and the feamle was taken at that time. One beetle larva was found with an external parasite larva on it. presumably that of *Odontocolon canadense.* The shallow tunnels of the beetle larvae made attack by the parasite possible. The ovipositor of the parasite is approximately 15 mm long, more than adequate to reach the typically 10 mm deep burrows of the beetle larvae even if bark intervenes. The other recorded host for this parasite is a species of *Tetropium* (Coleoptera: Cerambycidae) (Muesebeck *et al* 1951:207). Other species of *Odontocolon* parasitize wood-boring beetle larvae also (Townes & Townes 1960:449).

Dexcription of the Mature Larva of *Serropalpus Coxalis*

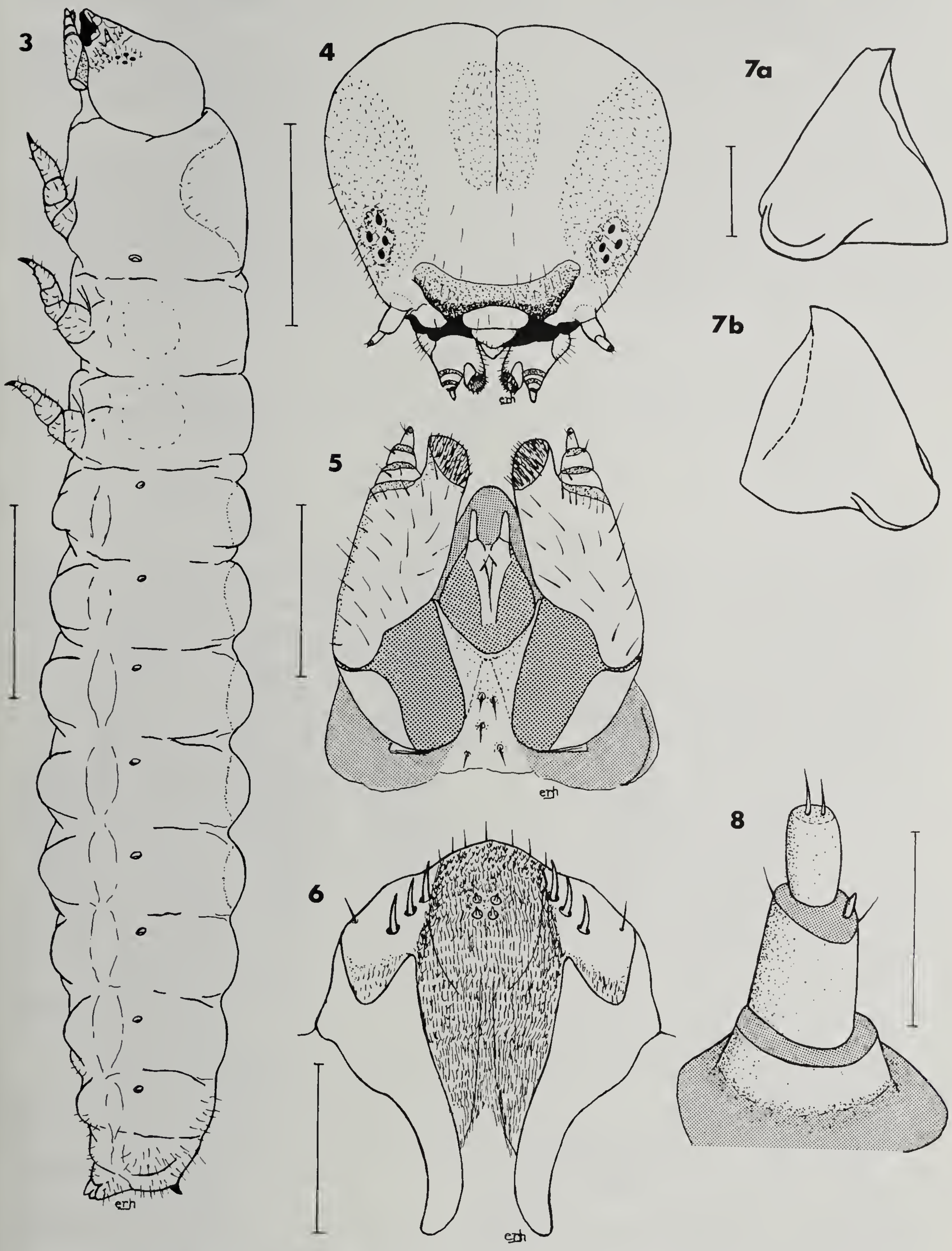
Measurements. 15.0-20.0 mm long; 3.0-4.0 mm wide; orthosomatic, cylindrical (Fig. 3); body near white with numerous scattered setae; head yellow-brown with dark markings above clypeus and along lateral aspects.

Head. Large, exserted, prognathous, slightly depressed from front, rounded, dorsal hind margin almost straight, possessing coronal suture, with distinct endocarina, "Y arms" lacking (fig. 4); 2 pairs of ocelli posterior of each antennal fossa; antennae (Fig. 8) extremely small, arising between base of mandibles and ocellar patch, 3-segmented; first segment short, transverse; second segment cylindrical, slightly longer than first; sensory appendage of second segment very small; third segment small with few stout apical setae; clypeus broadly transverse; labrum semicircular, somewhat produced along anterior margin; epipharynx (fig. 6) with posterior rods somewhat elongate, with a row of 3 prominent setae along each side of anterior part of midline, and with 4 sensory sensillae in center of disk; frons broadly emarginate along anterior margin; mandibles (fig. 7) prominent, deeply sclerotized and pigmented, robust, blunt, basal part without molar structure; maxilla (fig. 5) somewhat protracted with single, conspicuous, subtriangular to quadrate cardo, a large, fused stipes clothed with setae, and an entire setiferous mala; palpus 3-segmented, tapering to end, segments decreasing in width to end, terminal segment small, almost acicular; articulating membrane present between cardo, stipes, and postmentum; labium (fig. 5) with distal prementum bearing small, 2-segmented palpi, and a proximally fused mentum and submentum; ligula projecting beyond apex of labial palpi, devoid of setae.

Thorax. Prothorax slightly longer and larger than mesothorax and metathorax combined, with inconspicuous, lightly sclerotized dorsal shield, and weakly sclerotized ventral "breastplate"; legs comparatively small; tibia nearly subequal to femur in length; claw slender with 2 setae; prothoracic spiracle unicameral, oval, conspicuous; lateral fleshy swellings present on mesothorax and metathorax.

Abdomen. Distinct fleshy swellings on lateral ventral aspects of segments 1 through 8; lateral longitudinal folds also present on segments 1 through 8; segment 9 (Fig. 3) with 2 short, sharp-pointed, slightly curved, sclerotized, caudal, dorsal, projecting hooks or urogomphi; spiracles annular to oval, conspicuous, without chambers on margin.

Specimens examined. Nine mature larvae, Ithaca, Tompkins County, New York, 14 June, 1975, from *Tsuga canadensis* log, E. R. Hoebeke and T. L. McCabe, collectors. Determined by association with reared adults.



Figs. 3-8, Larva of *Serropalpus coxalis:* 3, mature larva; 4, frontal, dorsal aspect of head; 5, maxilla and labium, ventral; 6, epipharynx; 7, mandibles, (a) ventral, right mandible and (b) ventral, left mandible; 8, antenna. [scale line = 3.0 mm for Fig. 3; 1.0 mm for Fig. 4; 0.5 mm for Fig. 5; 0.15 mm for Fig. 6; 0.25 mm for Fig. 7; and 0.1 mm for Fig. 8].

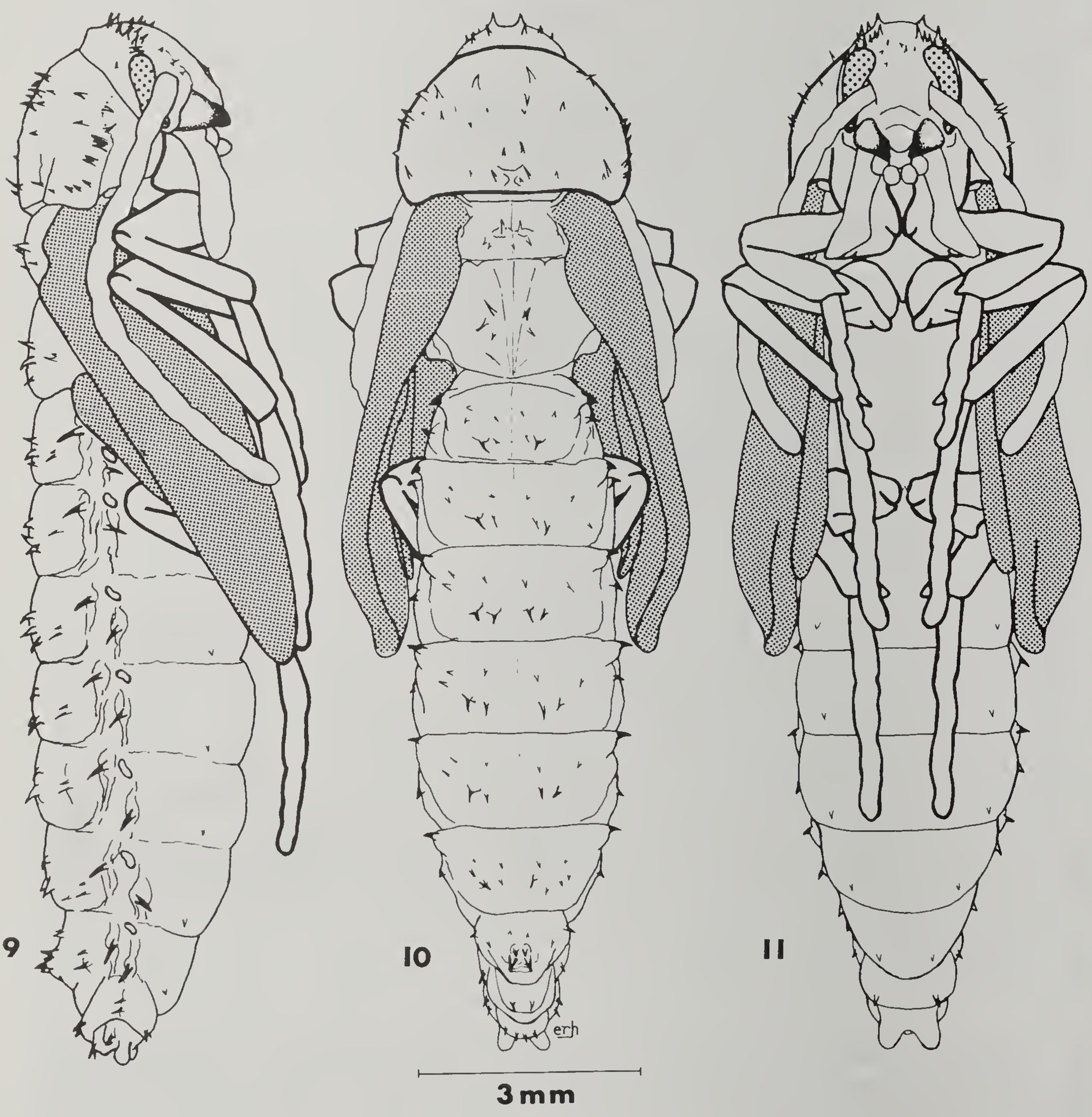
Description of the Pupa of *Serropalpus coxalis*

Measurements. 13.0-15.0 mm long; 3.0-4.0 mm wide; color whitish; exarate.

Head. Size moderate, partially covered above by hood-shaped pronotal disk, ornamented with sclerotized, irregular tubercles above posterior margin of eyes to vertex (Figs. 9 and 11).

Thorax. Prothorax large, hood-shaped, slightly shorter than combined length of mesothorax and metathorax; prothoracic disk with irregular tubercles, most prominent near lateral margins; mesothorax with conspicuous spines on dorsum; metathorax large with dorsal spines.

Abdomen. Segments 1 through 7 each bearing 2 major lateral tubercles on each side, 1 above spiracle and 1 on same level and behind spiracle (=pleural tubercle) (Fig. 9); segment 1 with pleural tubercle approximate to spiracle; segments 2 through 7 with pleural tubercles distant from spiracles; tergites 1 through 6 clothed with irregular curved spines (Fig. 10); tergite 7 small, with 2 pairs of large tubercles on fleshy swelling



Figs. 9-11, Pupa of *Serropalpus coxalis*: 9, lateral aspect; 10, dorsal aspect; 11, ventral aspect.

of caudal aspect of segment (Figs. 9 and 10); tergite 8 small, with 1 caudal spine on each side of midline; tergite 9 inconspicuous with caudal spines; small, inconspicuous spines on lateral caudal aspects of all sternites (Figs. 9 and 11).

Specimens examined. Twelve pupae, collected in Ithaca, Tompkins County, New York, 14 June, 1975, from log of *Tsuga canadensis,* E. R. Hoebeke and T. L. McCabe, collectors. Determined by association with reared adults.

ACKNOWLEDGMENTS

We wish to thank T. J. Spilman (Department of Entomology, U. S. National Museum) and J. L. Lawrence (Museum of Comparative Zoology, Harvard University) for valuable suggestions in preparation of the manuscript. In addition we wish to thank J. G. Franclemont and L. L. Pechuman, Cornell University, for helpful criticism of the manuscript. H. K. Townes, American Entomological Institute, Ann Arbor, Michigan, is acknowledged for verifying our determination of the ichneumonid parasite. G. A. Goldberg is commended for alerting us of the location of the log from which the beetles and parasites were collected. We also wish to express our appreciation to John E. Rawlins for the habitat photographs presented here.

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BOOK REVIEW

Cerambycidae of North America. Part VI, No. 2. Taxonomy and classification of the subfamily Lepturinae. By E. Gorton Linsley and John A. Chemsak. 1976. Univ. Calif. Publ. Entomology 80: ix + 186 p. $8.75.

It is with great pleasure that I announce the birth of this volume, a continuation of the monograph of North American Cerambycidae. Now, this great study seems much nearer to completion; only the Lamiinae remain, and the authors must be encouraged to continue onward to the end. For North American Coleoptera this project is a trailblazer. Similar studies are needed of our other large families, notable Carabidae, Staphylinidae, Scarabaeidae, Chrysomelidae, and Curculionidae. Who will assume these tremendous tasks? We do have Lindroth's magnificent treatment of the northern Carabidae, but still nothing for the United States. Monographs of the poorly known Staphylinidae and Curculionidae, sorely needed though they are, clearly remain for the distant future; but work on the other families should begin at once.

As one without practical familiarity with Cerambycidae, I shall not here do a detailed, analytical review; format and standards are as in previous volumes. One particular observation, however, is that this work is the second and concluding part of the treatment of the Lepturinae; it must be used in conjunction with Part VI, No. 1 (Univ. Calif. Publ. Ent. 69: viii + 138 p., 2 pl.), particularly since the key to genera of Lepturini is a continuation (couplets 1-22 in No. 1, couplets 23-57 in No. 2).

By my rough count, new taxonomic conclusions are the following: New taxa—6 genera, 1 subgenus (subgenera are treated only for *Pidolia*), 4 species, 8 subspecies; new status—1 genus (elevated from subgenus), 2 subspecies (reduced from species); new generic combinations—22 species, 4 subspecies; and new synonymies— 1 genus; group name, 16 species-group names. These figures reflect previous confusion at generic level; unfortunately, although the stated intent of this reevaluation was to clarify evolutionary relationships, no detailed explanations are given. The combination of few new species but numerous new synonymies results from the relatively intensive study given members of this family over the years. Knowledge of the species and their distributions is generally sufficient to now permit detailed studies of relationships at infraspecific levels. In my opinion, detailed discussions of variation are of more value than formal recognition of subspecies, but where the authors have distinguished subspecies they seem to have done so on a meaningful geographic basis.

Some general criticisms, which obviously should not be considered for future volumes of this series but rather for similar studies of other families, are these. (1) The table of contents might be expanded into a checklist, giving authors names and (ideally) also listing synonyms. (2) Information of status and location of type-specimens should be included, as is the statement on type-locality. (3) Critical, key characters should be illustrated; habitus figures might be given for a representative of each genus, rather than the more random format used here; and at least some genital figures should have been prepared, if only to illustrate their minimal usefulness for cerambycid taxonomy. (4) My principal objection is in the distribution maps: These should be given for all species, allowing the user to make direct comparisons; I note also that some of the maps that are used (as on pp. 127, 128) take up far more space than they justify.

These brief comments form only a minor aside. Students of Cerambycidae surely will find this book indispensable for at least the rest of this century. All coleopterists must stand in salute to this monumental work.

—D. R. Whitehead

* * *

BIOLOGY AND IMMATURE STAGES OF *CYLINDROCOPTURUS QUERCUS* (SAY) (COLEOPTERA: CURCULIONIDAE)

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Abstract

The life history and habits of *Cylindrocopturus quercus* (Say), a curculionid associate of common ragweed, *Ambrosia artemisiifolia* L., are discussed. Adults began appearing in early June with peak populations emerging in late June. Eggs were deposited in the basal half of a stem near nodes. Larvae tunneled and fed upon cortical, vascular, and pith parenchyma tissues. The mature larvae overwintered in a state of temperature-induced quiescence. Pupation occurred during the spring in specially prepared chambers located at the ends of larval burrows. The weevil is univoltine in northeastern Ohio. Diagnostic descriptions and illustrations of the immature stages are presented for the first time.

Introduction

Common ragweed, *Ambrosia artemisiifolia* L. (Compositae), is a well-known medically important, aeroallergenic pollen-producing plant responsible for late summer hayfever throughout much of North America. In northeastern Ohio, the weed supports a diverse assemblage of phytophagous Coleoptera, many of them poorly known biologically. One such insect is the curculionid *Cylindrocopturus quercus* (Say). Since the insect fauna attacking the ragweeds is of current interest in biological control (Harris and Piper 1970, Kovalev and Runeva 1970, Gilstrap and Goeden 1974, Goeden *et al.* 1974, Goeden and Ricker 1974a, b, 1975, 1976) and because no biological information was available on the life history and habits of *C. quercus,* the present study was initiated.

The genus *Cylindrocopturus* Heller (Curculionidae: Zygopinae) contains 42 Nearctic and Neotropical species, 28 of which are restricted to the United States (C. W. O'Brien, pers. comm.). The adult taxonomy of the genus is relatively well understood. In contrast, comparatively few detailed larval and pupal descriptions have been published (Keifer 1930, Anderson 1941). Larval feeding habits within the genus are quite varied (Pierce 1916, Buchanan 1940), but most species for which hosts are known are associated with members of the Compositae (Böving 1926). Species collected from ragweeds include *C. adspersus* (LeConte) from *A. acanthicarpa* Hooker, *A. chamissonis* (Lessing) Greene, *A. confertiflora* de Candolle, *A. psilostachya* de Candolle (Goeden and Ricker 1974a, b, 1975), and *A. trifida* L. (Pierce 1916, Hack 1935, Tuttle 1952); *C. operculatus* (Say) from *A. trifida* (Pierce 1916, Hack 1935, Tuttle 1952); *C. operculatus* (Say) from *A. trifida* (Tuttle 1952; *C. littoralis* (Fall) from *A. chamissonis* (Goeden and Ricker 1974b); and *C. quercus,* an associate of *A. artemisiifolia* (Kissinger 1963).

Biological observations of *C. quercus* are based on rearings initiated by adults, larvae, and pupae collected in or near the city of Kent (Portage County) in northeastern Ohio. Laboratory rearings were maintained at room temperatures of 20°-25°C, 50%-60% RH, and a 12/12 hr photoperiod.

LIFE HISTORY

Cylindrocopturus quercus has been recorded from New York, south to Georgia, and west to Iowa (Leng 1920). The oval, robust adults range from 2.3-3.0 mm in length and are covered with cupreous, tan, and white scales dorsally and grayish-white scales ventrally.

Adult emergence began during early June and essentially was completed by late July. Peak populations were found 2-3 weeks after the 1st emergence. Males emerged first, followed in a few days by the females. Both sexes were collected in approximately equal numbers throughout June and July. Laboratory-reared males lived from 30-40 days; females from 32-50 days. There was only 1 generation/yr in northeastern Ohio.

Adult feeding was restricted to ragweed leaves. The weevils cut holes through the upper epidermis with their mandibles, inserted their rostrums into the punctures, and devoured the mesophyll between the upper and lower epidermal layers. Heavily damaged leaves (Fig. 1) were chlorotic, and leaf abscission usually occurred prematurely.

In nature, adults rarely were seen moving about on the foliage and were not easily collected. Most commonly the weevils were found clinging to the stems. In the laboratory, *C. quercus* adults were most active during the late morning and early evening hours. The weevils are thanatotropic and drop immediately when disturbed, their coloration blending with the soil and/or litter beneath the host plants.

The premating period (from emergence to 1st copulation) of 10 laboratory-reared females ranged from 4-6 (X=5) days. No definitive courtship behavior was observed. All matings observed in the field occurred on the lower surfaces of leaves and in leaf axils of common ragweed. The male mounted the female by approaching from either the front or rear. When the male approached and mounted from the front, he immediately reversed his position on the female and aligned his body with hers so that both faced in the same direction. The male grasped the female in the following manner: The front legs were positioned against the prothorax just caudad the compound eyes; the middle legs grasped the abdomen between the female's middle and front legs; and the hind legs were lightly appressed against the abdomen near the genitalia (Fig. 2). Most females generally were quite passive after the initiation of copulation and often fed while in copula. Occasionally a female would attempt to dislodge a male by swinging her abdomen back and forth transversely in pendulum fashion. When the female started to move to a new location on the plant, copulatory activity was suspended immediately; the male merely rode the female's dorsum until another feeding site was selected. Mating time (from mounting to cessation) varied from 5-60 min. Adults in copula were infrequently seen or collected in nature. In the laboratory, mating occurred repeatedly during the period preceding the 1st oviposition, but steadily declined in frequency as the female aged. Mating occurred at various times of the day in the rearing containers.

The preoviposition period (from emergence to 1st deposition of eggs) of 4 females varied from 8-15 days. These females each laid an average of 2 eggs/day over a 10-37 day period. Daily egg-laying varied from 0-7 eggs/female, and the total number of eggs laid/female ranged from 17-83. Oviposition was restricted to the late morning or early afternoon hours. A gravid female usually selected a site on the lower third or two-thirds of a stem, directly beneath a leaf petiole base, for oviposition.

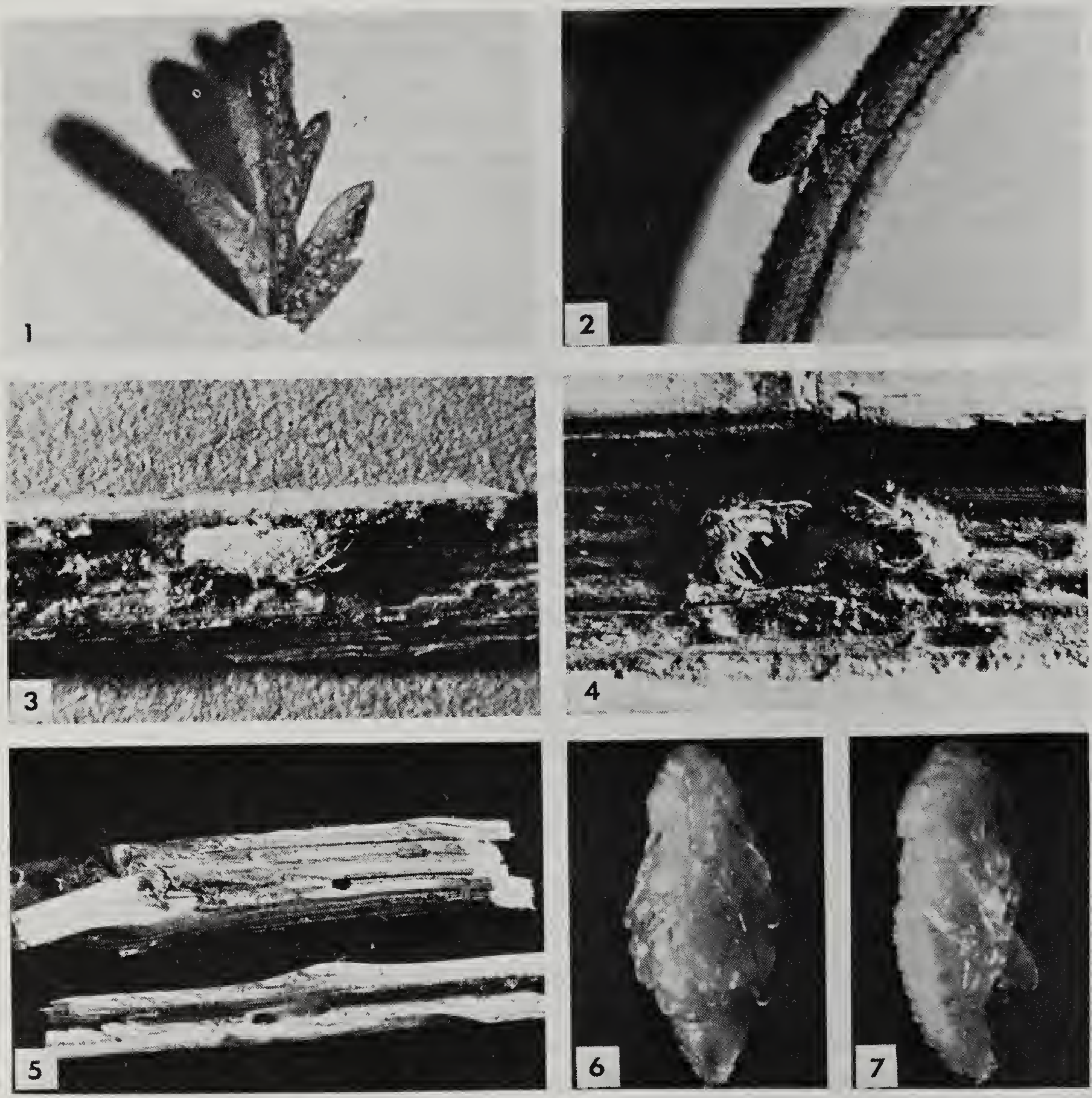
She oriented her body on the stem with the head directed downward and chewed a hole through the epidermal and cortical tissues. Upon completion of the excavation, the female executed a 180° turn to the right, located the hole with the tip of the abdomen, and deposited an egg near the cavity. The female reversed her position again, pushed the egg inward with her rostrum, and proceeded to conceal the egg by using her mandibles to tease out the stem tissues bordering the oviposition hole. Only 1 egg was deposited/hole. The total time required for egg chamber excavation and oviposition was 15-20 min. Commonly 8-10 eggs were found per stem. The incubation period of 25 eggs held at room temperatures ranged from 8-10 ($X = 9$) days. The viability of these eggs exceeded 90%.

Larval emergence was preceded by vigorous peristaltic inflation and contraction of the body, flexing of the head, and mandibular movement. Larvae initially ruptured the chorion with their mandibles, enlarged the tear thru body movements, and eventually emerged from the egg. The head was the last portion of the larva to be extracted from the chorionic remnant.

Upon hatching, larvae fed upon the decaying tissues within the egg chambers. Second-stage larvae tunneled cortical and vascular tissue. Feeding activity of third-stage larvae resulted in destruction of portions of the vascular tissue (leaf trace severance) and pith. The linear feeding galleries varied from 1-3 ($X = 2$) cm in length and were packed with fine powdery frass. Even though as many as 10 larvae were found per stem, the extensive tunneling did not appear to distress the weed. Larval feeding damage occurred too late in the growing season to have any significant effect upon the competitive or reproductive capacities of ragweed. The length of time spent in each larval stadium could not be determined accurately, but the first stadium generally was completed in 4-5 days, and the second stadium in 12-20 days under laboratory conditions. Mature larvae remained in the third stadium from early fall until the following May or June.

From late August until mid-October, mature larvae constructed pupal chambers at the ends of the feeding galleries. The elongate, oval chambers (Figs. 3, 4) were situated against the inner stem wall and were constructed from frass, composed primarily of strands and flakes of sclerenchyma and xylem tissue, cemented together with larval excrement. The chambers, measuring 6 mm in length and 2 mm in diameter, were constructed so that their greatest length was parallel to the stem's upright axis. Once the cells were formed, the larvae chewed small emergence holes, approximately 1 mm in diameter, completely through the stem walls. The larvae then plugged the apertures with fine powdery frass. The amount of time required to complete the pupal chamber was not determined. The mature larvae overwintered in a state of temperature-induced quiescence within these chambers.

A definite prepupal stage in *C. quercus* was observed. Three to four days prior to pupation, larval activity slackened and the insect became distended. Larvae transformed into pupae from late April to mid-May. Field investigation revealed that the larvae always pupated head upward within the chambers. Sequential body coloration changes were observed throughout the pupal period. The first structures to darken were the eyes, followed in rapid succession by the mandibles, tarsal claws, and femora apices. The pupal period of 25 individuals lasted 11-15 (X=12) days. Adults emerged via the exit holes previously cut in the stem walls (Fig. 5).



Figs. 1-7. *Cylindrocopturus quercus*. 1) Adult feeding damage. 2) Mating position of adults. 3) Intact pupal cell. 4) Pupal cell cut away to reveal mature larva. 5) Emergence holes in stem. 6) Pupa, ventral view. 7) Pupa, lateral view.

Descriptions of Immature Stages

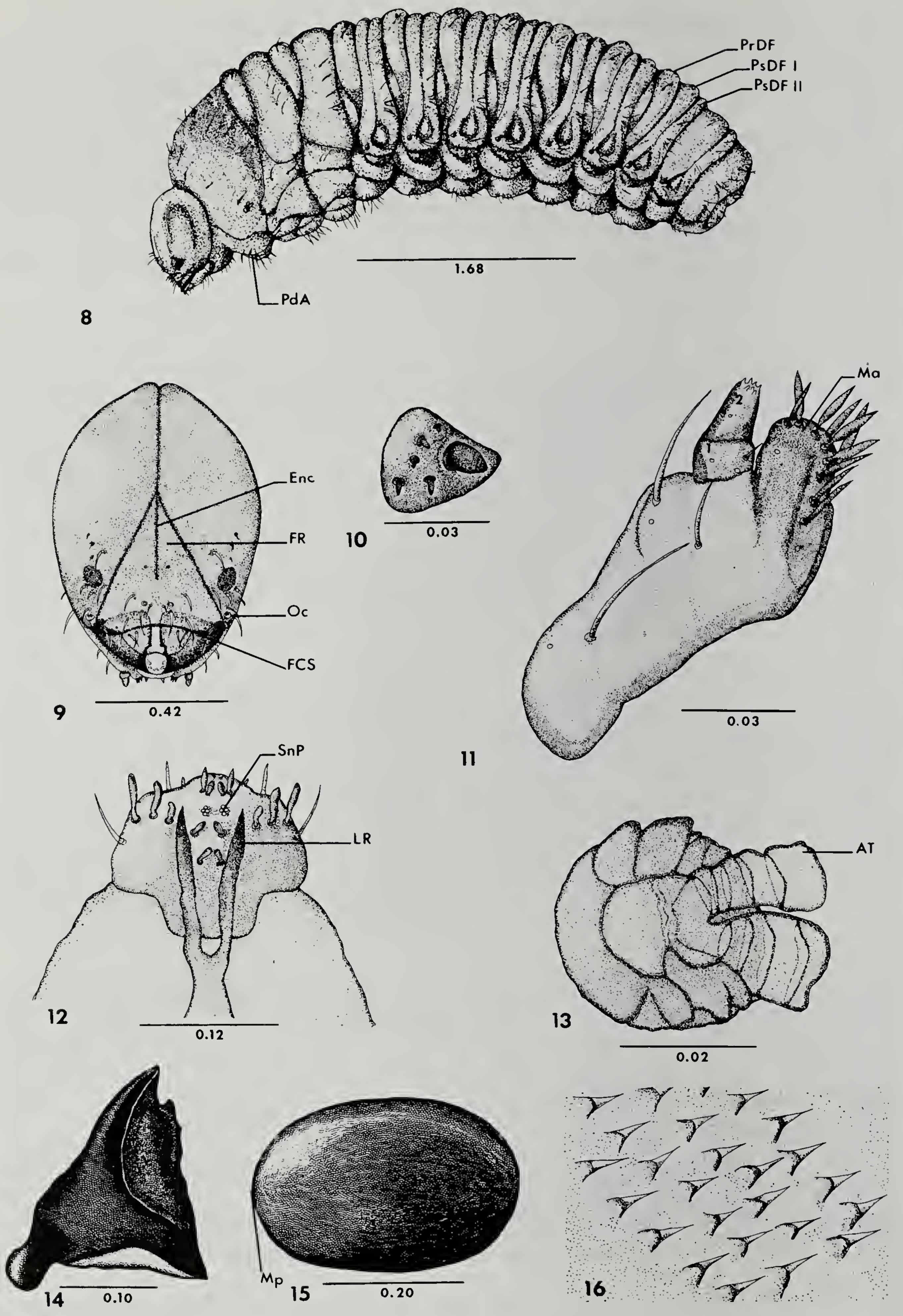
Egg. (Fig. 15). Length 0.35-0.43 mm, maximum width 0.25-0.27 mm (25 specimens). Yellowish-tan. Broadly oval, ends bluntly rounded; one end slightly larger than the other. Chorion smooth, without pattern. Micropyle located terminally.

First Instar. Terminology of larval characters follows Anderson (1947). Similar to third instar except in following characters. Length 0.33-0.45 mm, head capsule width 0.18-0.19 mm (25 specimens). Color translucent yellow. Prodorsal and postdorsal folds of meso- and metathorax and abdominal segments 1-7 not prominent; setae, except for those on head, minute.

Second Instar. Similar to third instar except in following characters. Length 0.72-0.92 mm, head capsule width 0.23-0.24 mm (25 specimens).

Third Instar (Fig. 8). Length 3.08-4.42 mm, head capsule width 0.50-0.72 mm (25 specimens). Color white or cream; integument thin, covered with many minute pointed asperities. Body subcylindrical, cyphosomatic, slightly tapered posterad. Head capsule yellowish-brown; elongate oval; posterior half of capsule retracted into prothorax. Endocarina distinct. Frontal suture V-shaped (Fig. 9), extending to antennal bases. Frons complete with 10 setae and 4 sensilla; frontal setae 1 and 2 shorter than either 3, 4 or 5; setae 3, 4 and 5 approximately equal in length. Antennae (Fig. 10) located at distal ends of frontal suture; basal article with 5 sensory papillae. Anterior ocelli present; lenses convex; pigment bodies present. Epicranial halves each with an oval, dark brown area posterad to each ocellus. Five pairs of dorsal epicranial setae present; setae 2 and 4 shorter than setae 1, 3, and 5. Lateral epicranial seta 2 longer than 1. Ventral epicranial setae 1 and 2 equal in length. Four pairs of minute posterior epicranial setae. Distinct fronto-clypeal suture present; clypeus twice as long as wide with 4 long setae and 2 sensilla. Labrum twice as long as wide with 3 pairs of setae, labral seta 1 longer than 2 or 3; 2 lateral sensilla present. Epipharynx (Fig. 12) with 3 flattened anterolateral setae on each side, 6 anteromedian setae, and 2 pairs of median spines; labral rods sclerotized; elongate; sub-parallel, convergent posteriorly. Epipharyngeal sensory pores in 2 clusters, 4 in each cluster, located anterior to the median spines. Mandibles (Fig. 14) stout, blackened and bidentate apically; mandibular setae 1 and 2 subequal in length. Apical article of maxillary palpus longer than basal article (Fig. 11); ventral inner surface of basal article with 2 sensilla placodea; apical article with 1 sensillum placodeum, tip of apical article invested with 7-8 sensilla basiconica; inner margin of maxillary mala with 5 ventral setae and 7 dorsal spatulate setae. Prementum of labium with 2 short setae; premental sclerite reddish-brown; trident shaped. Glossa with 4 small setae. Basal article of labial palpus longer than apical article; tip of apical article with 5-6 sensilla basiconica. Postmentum with 3 pairs of setae. Pronotum non-lobate; lightly sclerotized; complete with 20 setae, 10 on each side of meson; posterior half asperate (Fig. 16). Prothoracic epipleural lobe without setae; pleural lobe with 2 setae; sternum with 2 setae. Prodorsum of meso- and metathorax each bearing 1 short seta on each side of meson; postdorsum of meso- and metathorax each bearing a row of 4 setae on each side of meson. Meso- and metathoracic epipleural lobes each with 2 setae; meso- and metathoracic pleural lobes each with 1 seta. Meso- and metasternum each with 2 setae. Legless. Pedal areas of thoracic segments protuberant; each with 6 setae. Abdominal segments 1-7 each with 3 dorsal folds. Postdorsal folds of segments 1-7 more prominent than prodorsal folds. Prodorsum of each segment with 1 seta on each side of meson; postdorsum of each segment with a row of 4 setae on each side of meson. Epipleural lobes prominent on segments 1-8, each with 2 setae; pleural lobes each with 1 seta; pedal areas small, bearing 1 seta. Eusternum of segments 1-8 with 4 setae; sternellum glabrous. Segment 8 with 2 dorsal folds. Segment 9 subconical with 6 setae. Anus terminal; surrounded by 4 lobes; dorsal and lateral lobes each with 2 setae. Spiracles bicameral, small, air tubes with 4-5 annuli; peritremes feebly sclerotized (Fig. 13). Paired spiracles located on mesothorax and abdominal segments 1-8; mesothoracic spiracle largest; all spiracles ringed with black.

Pupa (Fig. 6, 7). The terminology of pupal characters follows Burke (1968). Length 3.38-3.96 mm (25 specimens). Body closely resembling form of adult in size, shape, and proportions of cephalic and thoracic appendages; exarate; color creamy white. All spines and setae arise from tuberculate bases; dark brown. Rostrum and antennae extending to anterior margin of mesothoracic sternum; 2 pairs of short distirostral setae near middle of rostrum; 1 pair of long basirostral setae near rostrum base. Head small, rounded; 1 pair of long supraorbital setae; 1 pair of short frontal



Figs. 8-16. *Cylindrocopturus quercus,* third instar larva and egg. 8) Lateral habitus, head exserted. 9) Head capsule, frontal view. 10) Antenna. 11) Right maxilla, ventral view. 12) Epipharynx, ventral view. 13) Abdominal spiracle. 14) Right mandible, ental view. 15) Egg. 16) Pronotal spines. All measurements indicated by scale lines are in millimeters. AT, air tube; Enc. endocarina; LR, labral rod; FCS, frontoclypeal suture; FR, frons; Ma, Mala; Mp, micropyle; Oc, ocellus; PdA, pedal area; PrDF prodorsal fold; PsDF, postdorsal fold; SnP, sensory pore.

setae. Prothoracic depressions lacking. A pair of anteromedian setae near anterior margin of pronotum; 2 pairs of widely separated anterolateral setae; 1 pair of widely separated posteromedian setae near middle of pronotum; 4 pairs of posterolateral setae. Mesonotum smooth with a pair of closely spaced mesonotal setae on each side of midline; scutellum protuberant, glabrous. Mesothorax with a large, oval, functional spiracle. Metanotum smooth, shining; pair of metanotal setae on each side of scutellar groove. Elytra and wings extending to anterior margin of abdominal sternum 4. Abdominal terga 1-7 protuberant; 2 pairs of discotergal setae and 1 pair of laterotergal setae on each tergum. Tergum 8 short, tapered; 1 pair of discotergal setae. Abdominal segment 9 short, concealed below 8; armed with a pair of long, widely separated, strongly chitinized posterior processes. Sterna shining, glabrous; sternum 3 the largest. Legs each with 2 setae near apex of femur, hind femora extending to abdominal segment 5; tibiae and tarsi directed posterad. Functional spiracles on segments 1-7; annular; non-sclerotized.

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BOOK REVIEW

Entomology in the U.S.A., edited by A. P. Gupta. 1976. The XV International Congress of Entomology, Washington, D.C. (distributed by the Entomological Society of America, 4603 Calvert Rd., College Park, Md. 20740). Paper, 159p., $3.00.

This brochure is the result of an attempt to provide a single source of information on ". . . entomologists and entomological centers in this country." It was compiled by members of the National Brochure Committee of the Entomological Society of America. Very brief summaries of the origin and history of this society as well as its five branches are presented in the first seven pages. The bulk of the remaining pages contain a listing, of states (including D.C.), of entomological centers and staff. The centers for each state are grouped under ten categories: Universities; Colleges; Industrial and Private Organizations; State Government Organizations; USDA–Agricultural Research Service; USDA–Animal and Plant Health Inspection Service; USDA–Forest Service; HEW–Public Health Service–Center for Disease Control; EPA; and Miscellaneous. For each center the authors provide (1) a brief summary of its history and activities, (2) a short statement (often one word) as to its function, and (3) a list of staff members giving their titles, their highest degrees and fields of interest (ecology, medical entomology, physiology, etc.). Unfortunately, taxonomic interest listings are limited to staff members of museums (under Miscellaneous). Had taxonomic interests been given for *most* entomologists listed in the brochure, this volume undoubtedly would be a superb contribution to entomology. In all fairness, however, it must be stated that it *is* a very good compilation of information on entomology in the U.S.A.

—Paul P. Shubeck

CALOSOMA (CASTRIDA) ALTERNANS GRANULATUM PERTY: A PREDATOR OF COTTON LEAF WORMS IN BOLIVIA (COLEOPTERA: CARABIDAE: CARABINI)[1]

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ABSTRACT

The ground beetle, *Calosoma (Castrida) alternans granulatum* Perty, is an efficient predator of the cotton leaf worms *Alabama argillacea* (Hübner) and *Spodoptera frugiperda* (J. E. Smith) in Bolivia and is a highly promising biological control agent against these pests. Field investigations indicate that these beetles are capable of keeping leaf worm populations within economically acceptable limits, thus eliminating need for at least 1 and perhaps 2 initial insecticide applications. *C. a. granulatum* should therefore be considered as a potentially highly useful element in integrated biocontrol programs against cotton pests elsewhere in South America and also in the agricultural ecosystem on the southern United States.

Species belonging to the genus *Calosoma* (the caterpillar hunters) have been known since at least 1840 to be voracious predators on lepidopterous larvae (DeBach 1964). Their ability to climb plants large enough to support them, the speed with which they move, and their large size make them formidable enemies of any lepidopterous immatures they may encounter. Burgess (1911a, b) and Burgess and Collins (1915, 1917) have studied the biology of many species of *Calosoma,* especially *C. sycophanta* L., found in the Northeastern part of the United States. These workers were able to utilize some of the native species and *C. sycophanta,* which was introduced into the U.S. from Europe, as biological control agents against the Gypsy Moth, *Porthetria dispar* (Linn.). Gidaspow (1959, 1963) studied the taxonomy of the genus in North and South America.

During the north temperate winter months of 1970-71 and 1971-72 I worked for the Associacion de Productores de Algodon in Santa Cruz, Bolivia as a consultant on entomological problems associated with cotton. The principal objective of the work was to develop an integrated control program that would maximize the use of native beneficial insects and reduce insecticide applications. During a normal cotton growing season in Bolivia the first major insecticide applications are made for the control of cotton leaf worms, principally *Alabama argillacea* (Hübner) (Fig. 1) and *Spodoptera frugiperda* (J. E. Smith). I found that the carabid *Calosoma (Castrida) alternans granulatum* Perty (Fig. 2) was a major predator on these two leaf worms both in the larval and pupal stages (Fig. 3). *C. a. granulatum* was very abundant in cotton fields around Santa Cruz and readily fed on the leaf worms during the day and at night. The beetles were present during December, January, and February and are readily attracted to street lights and black lights.

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[1] Published with the approval of the Director, Arkansas Agricultural Experiment Station.

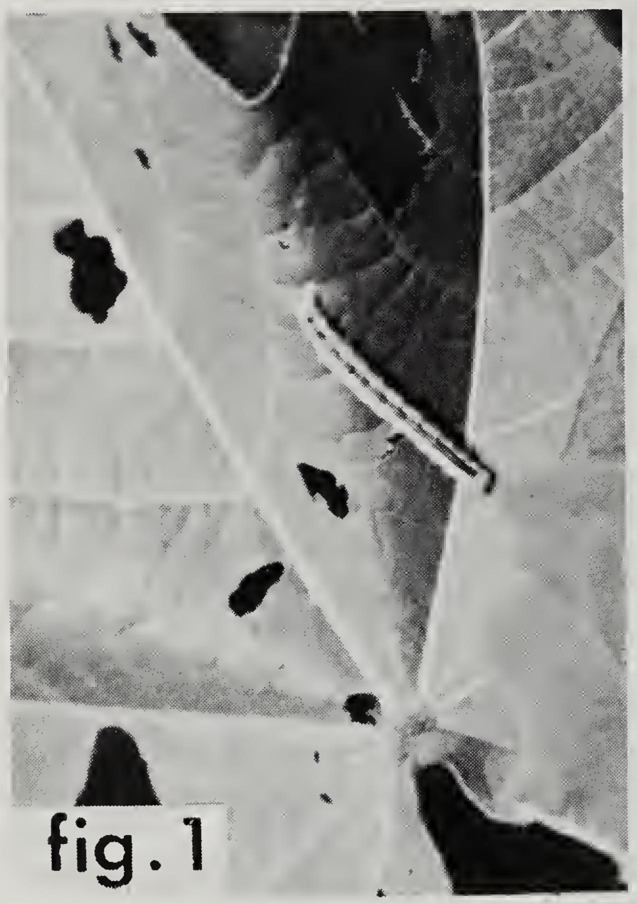

fig. 1

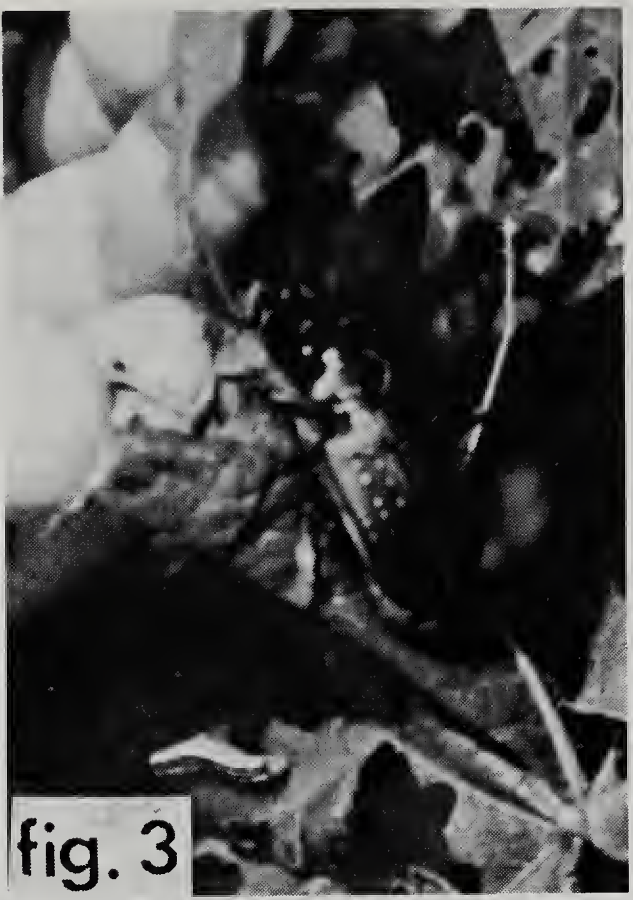

fig. 3

Figure 1. *Alabama argillacea* (Hübner) feeding on cotton.

Figure 3. *C. a. granulatum* feeding on pupa of *A. argillacea* on cotton.

This information coupled with the fact that a cotton plant can suffer 30% to 40% defoliation without a reduction in yield (Charles G. Lincoln, personal communication)[2] provided an opportunity to utilize *C. a. granulatum* as a biological control agent. I also found that as the plants were reaching 40% defoliation many of the leaf worms had completed feeding and were beginning to pupate in the leaves on the cotton plants. Thus it appeared that if insecticide applications were not applied the *Calosoma* beetles would have an opportunity to attack and devour both the leaf worm larvae and the very vulnerable pupae. The predation on the larvae would considerably reduce immediate damage to the plant, and predation on the pupae would reduce the numbers in the next generation of leaf worms.

Several cotton growers (representing about 2,500 ha.) agreed to try a non-insecticide control program for leaf worms provided that daily checks were made of the fields involved, instead of the normal once a week check. With the help of Bolivian cotton scouts the program was initiated and proved to be successful. By allowing the predator to minimize this initial stage of leaf worm damage, at least 1 and possibly 2 insecticide applications were saved. More importantly the resident predator and parasite populations were protected from the adverse effects of the insecticide. It is my conclusion that *C. a. granulatum* may prove to be a valuable biological control agent in other areas of South America. This species might also be of value in the agricultural ecosystem of the southern United States.

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[2] Entomology Department, University of Arkansas, Fayetteville, AR 72701.

fig. 2

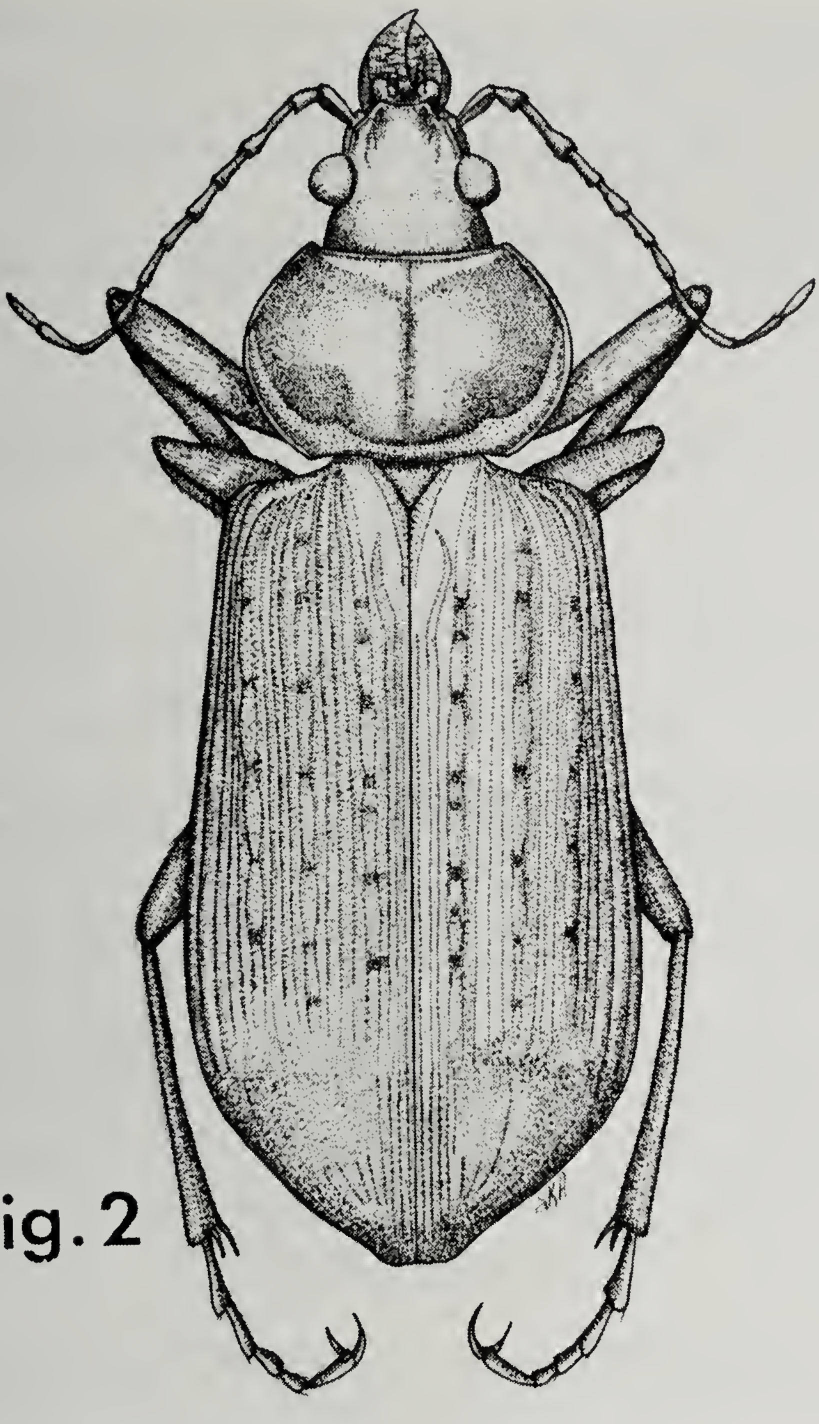

Figure 2. *Calosoma (Castrida) alternans granulatum* Perty, habitus.

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LITERATURE NOTICES

Notes on the life cycle and myrmecophilous adaptations of *Cremastocheilus armatus* (Coleoptera: Scarabaeidae), by Gary D. Alpert and P. O. Ritcher. 1975. Psyche 82(3-4):283-291.

The phytophagous insect fauna of the Ragweed, *Ambrosia dumosa,* in Southern California, by Richard D. Goeden and Donald W. Ricker. 1976. Environmental Entomology 5(1):45-50.

The role of Seed-corn Beetles in predation of Cabbage Maggot immature stages, by J. A. Wyman, J. L. Libby, and R. K. Chapman. 1976. Environmental Entomology 5(2):259-263.

—Paul P. Shubeck

JOURNAL NOTICES

The Royal Entomological Society of London has changed the names of its Journals as follows:

Ecological Entomology continues from Transactions of the Royal Entomological Society of London, founded in 1834.

Physiological Entomology continues from Journal of Entomology (Series A), founded in 1926.

Systematic Entomology continues from Journal of Entomology (Series B), founded in 1932.

—Paul P. Shubeck

BOOK NOTICES

The distribution and diversity of soil fauna, by John A. Wallwork. 1976. Academic Press, 111 Fifth Avenue, New York, NY 10003. Hardbound, 356p., $27.25.

The mathematical theory of the dynamics of biological populations, ed. by N. S. Bartlett & R. W. Hiorns. 1973. Academic Press, 111 Fifth Avenue, New York, NY 10003. Hardbound, 348p., $21.50.

Perspectives in forest entomology, ed. by John F. Anderson & Harry K. Kaya. 1976. Academic Press, 111 Fifth Avenue, New York, NY 10003. Hardbound, 483p., $17.50.

Man's plague?, by V. G. Dethier. 1976. Darwin Press, Princeton, NJ 08540. Hardbound, 238p., $9.95.

—Paul P. Shubeck
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A NEW SPECIES OF *ISOPLASTUS* FROM MEXICO (LEIODIDAE: LEIODINAE)

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ABSTRACT. A new species of *Isoplastus* Horn, *I. uncus*, is described from Mexico, extending the geographic range of the genus into Central America.

Sifting forest floor litter in the vicinity of Fortin de las Flores produced a new species of *Isoplastus* which greatly resembles *I. fossor* Horn in general appearance.

Isoplastus uncus Wheeler, **New Species**

Holotype. Male. Mexico: State of Veracruz, Fortin de las Flores, 28-VI-1975, Q. D. Wheeler, in sifted forest floor litter, (MCZC) (1).

Diagnosis. *Isoplastus uncus* is distinguished by a pair of hooked processes at the apex of the aedeagal internal sac (fig. 1).

Description. Body broadly oval, very convex, slightly contractile, rufo-testaceous, and shining; length 2.4 mm.

Head sparsely, finely punctulate, punctures coarser and closer at posterior margin; slightly more than 3/5 as wide as anterior margin of pronotum.

Thorax more than twice as wide as long, narrowed in front; apex emarginate, base arcuate, hind angles obtuse. Surface sparsely and very minutely punctulate.

Elytra with slightly oblique humeri, obtusely rounded. Surface with 8 rows of fine, closely placed punctures; those of disc only slightly irregular; intervals flat, minutely punctulate.

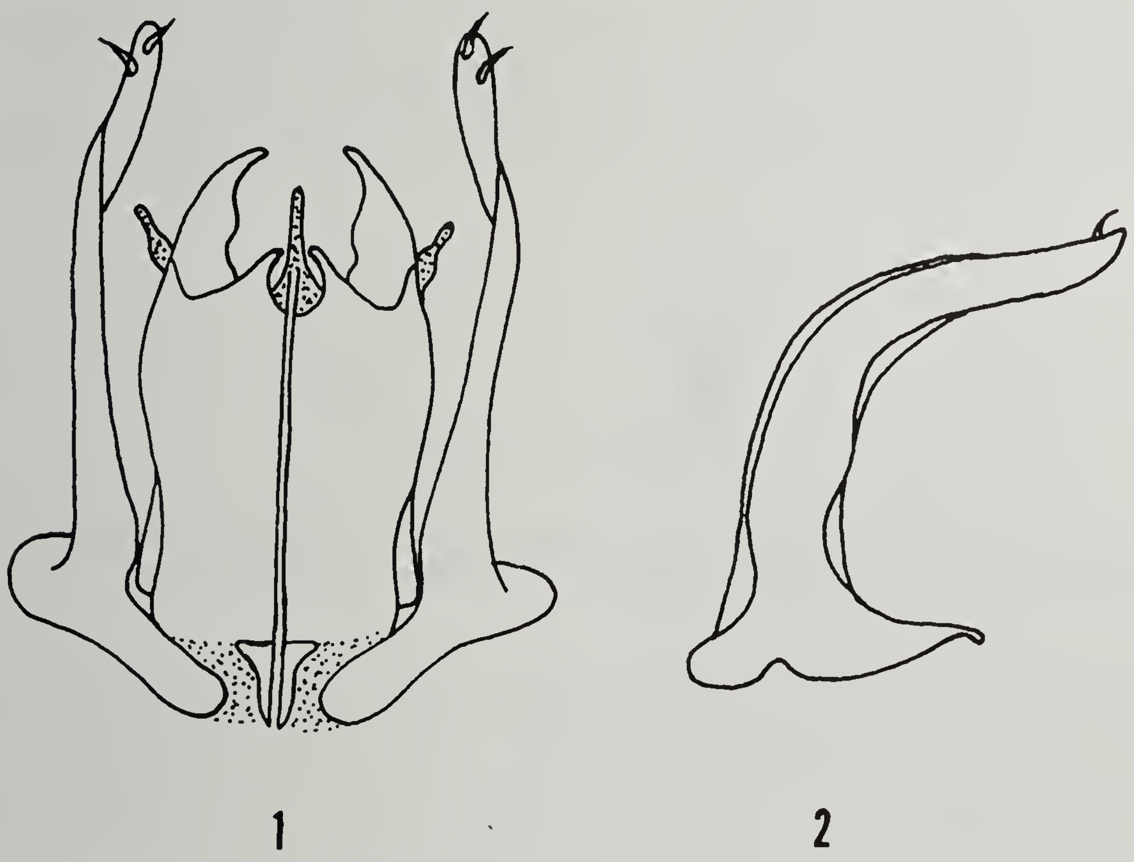

Fig. 1-2, *Isoplastus uncus* Wheeler: 1) aedeagus, dorsal view; 2) aedeagus, lateral view.

Metasternum coarsely punctured throughout, punctures larger at sides.

Abdomen six-segmented; obsoletely punctate.

Male anterior and middle tarsi little stouter than hind tarsus. Posterior femur with outer condyle prolonged into narrow unciform process. Tarsi 5-5-4, each very compressed. Femora and tibiae very broad; mesotibiae strongly and irregularly spinose, metatibiae much less so.

Aedeagus with median lobe short, broad, and ventrally curved; internal sac with pair of hook-like processes apically, pair of small membranous lobes laterally, and elongate membranous process medially; parameres long, twisted, bisetose; basal piece not connected dorsally or ventrally (figs. 1 and 2).

Female unknown.

Other characters as in generic description (Horn, 1880).

Etymology. The species is named for the form of the outer condyle on the male metafemora.

Distribution. Known only from the type locality.

Discussion. The metasternal punctation may be of diagnostic value. In *I. uncus* the punctures are coarsely impressed throughout, whereas in *I. fossor* Horn the punctures are lightly impressed or absent at the midline. However, without the female of *I. uncus*, it is best to use the characters of the male genitalia for identification. In addition, the species appear to be geographically isolated; *I. fossor* is recorded from Quebec, Michigan, Ohio, and the District of Columbia, and *I. uncus* is recorded from the state of Veracruz (Mexico). Brown (1937) discusses *I. fossor*, and figures the aedeagus.

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BOOK NOTICE

The Long-Horned Wood-Boring Beetles of North Dakota (Coleoptera: Cerambycidae), by John D. Stein and Arden D. Tagestad. USDA Forest Service Research Paper RM-171, pp. 1-58, illus. 1976.

For each of 73 species in 42 genera are given a photograph of the adult, the size, the distribution by counties in North Dakota with a map, a list of host plants, and a short summary of biology, time of activity, and damage caused. An index by host plants is also provided. The Literature Cited section contains many references to cerambycid biologies and a few to North Dakota distributions. Species of a few genera are omitted because of identification problems. The paper was published by Rocky Mountain Forest and Range Experiment Station, Forest Service, USDA, Fort Collins CO 80521.

—Anonymous

DESCRIPTIONS OF THE MALE OF *AGRILUS ESPERANZAE* KNULL AND THE FEMALE OF *AGRILUS OBLONGUS* FISHER, AND NOTES ON OTHER BUPRESTIDAE (COLEOPTERA).

Gary V. Manley
Standard Fruit Company, La Ceiba, Honduras

Abstract

The male of *Agrilus esperanzae* Knull and the female of *Agrilus oblongus* Fisher are described, and the male genitalia of *A. esperanzae* illustrated. Additional information is provided on the distribution and biology of other North American buprestids.

Actenodes flexicaulis Schffr. 1904, Jour. New York Ent. Soc. 41:197-236. One specimen emerged from a dead branch of Granjeno, *Celtis pallida* Torr., February 18, Hidalgo County, Texas. (**new host record**)

Agrilus cupricollis Gory 1841, Mon. Bupr. Supply. 4:240, pl. 40. Previously known only from Florida, Georgia, and Texas (Wellso 1973). Collected on May 15 in Clark National Forest, Phelps County, Missouri. (**new state record**)

Agrilus egeniformis Champlain and Knull 1923, Ent. News 34:84-5. Reared from soapberry (*Sapindus drummondii* Hook & Arn.) branches, Uvalde and Frio Counties, Texas. During April through July, adults were consistently collected from the foliage of soapberry in Frio County. (**new host record**)

Agrilus esperanzae Knull 1935, Ent. News 46:96-7. Described from a female collected at Brownsville, Texas, on June 3, 1934 by J. N. Knull. Four specimens (2 males and 2 females) were collected by me on March 24 and 25, 1975, Hidalgo County, Texas. A plesiallotype male is described from this series.

Description of male; Similar to the female except (1) front of head bright green and vertex cupreous, (2) ventral surface with median line of long white recumbent hairs from prosternal lobe to middle of first abdominal segment, and (3) without concentration of white hairs on sides of third abdominal segment. Genitalia as shown in figure 1. Length 4.0mm, width 1.0mm.

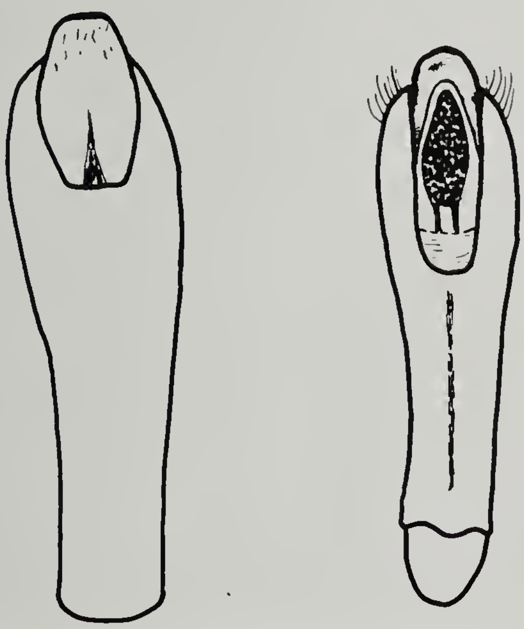

Fig. 1. Male genitalia of *Agrilus esperanzae* Knull, dorsal (left) and ventral (right) views.

Plesiallotype, male (writer's collection), Texas, northern Hidalgo County, March 24, 1975. Additional Texas specimens from Hidalgo County on April 7 and Frio County on March 29 and April 26.

Agrilus exiguellus Fisher 1928, U.S.N.M. Bull. 145:277-79. Three specimens from foliage of *Quercus* spp. south of Fort Worth, Tarrant County, Texas, May 10, 1974.

Agrilus gillespiensis Knull 1947, Ohio Jour. Science 47(2): 70-2. From foliage of *Celtis* sp., Uvalde County, Texas, April 18 and 19.

Agrilus limpiae Knull 1941, Ent. News 52:283-4. From foliage of soapberry in Uvalde, Bexar, Frio and Hidalgo counties, Texas. Collection dates ranged from March 2 in Hidalgo County to October 20 in Frio County. Adults emerged from dead soapberry branches, Frio County, from March 15 to August 28.

Agrilus neoprosopidus Knull 1938, Ohio Jour. Science 38(2):99. From foliage of Tepehuaje (*Leucaena pulverulenta* (Schlecht.) Benth.), February 2 to November 24, Hidalgo County, Texas. Adults of this species may be active all year in the Rio Grande Valley.

Agrilus oblongus Fisher 1928, U. S. Natl. Mus. Bull. 145:333-35. Previously reported only from Georgia, Maryland, and Virginia. Adults collected by sweeping along Little Piney Creek, Clark National Forest, Phelps County, Missouri, May 16. **(new state record)**

Description of female: similar to male in size and shape, but differs in the following characteristics: (1) front of head bright mahogany; body bronze, lacking the greenish coloration of the male, particularly ventrally and on the pronotum; elytra bronze, much lighter colored than the piceous male elytra; (2) feeble, broad depression along sutural margin of elytra in both sexes but female sutural depression with pubescent spot about 1/2 way from basal margin; (3) first segment of abdomen not flattened at middle; and (4) hairs on prosternum shorter and less numerous. Length, 5.3mm; width, 1.2mm.

Plesiallotype, female (writer's collection), Missouri, Phelps County, Clark National Forest, May 16, 1974.

In the 3 females examined the pubescent spots on the elytra are indistinct but indubitably present. Fisher (1928) does not note the pubescent spots on the elytra in the description of the male and I see no manifestation of it on males collected in Missouri. Due to the pubescent spots on the elytra, the female of this species would key to *A. cupreonitens* in Fisher (1928).

Agrilus obtusus Horn 1891, Trans. Amer. Ent. Soc. 18:288. *Cassia lindheimeriana* Scheele appears to be the host of this species. Adults were consistently collected from the foliage in Bexar County, Texas, from May 10 to October 24, usually from low growing plants. Adults were observed to feed on the leaves of *C. lindheimeriana* both in the field and in cages. Caged females readily laid eggs on the stems and leaves of *C. lindheimeriana*.

Egg laying in this species is uniquely complex and interesting for a buprestid. The female forms a mat of feces on the spot where the egg is to be laid. A single egg is laid near the middle of this feces mat, and exposed parts of the egg are covered by additional feces (Fig. 2). The young larvae emerge through the bottom of the egg and bore into the living plant.

Agrilus ornatulus Horn 1891 Trans. Amer. Ent. Soc. 18:319-20. Adults emerged during April from dead branches of soapberry, Frio County, Texas. Vogt (1949) reported adults from soapberry foliage, in Hidalgo County. Additional specimens were collected from soapberry foliage in the following Texas counties: Bexar, Brewster, Camanche, Colorado, Matagorda, and Tarrant. Collection dates ranged from March 22 to July 9. (**new host record**)

Agrilus scitulus Horn 1891, Trans. Amer. Ent. Soc. 18:318-19. Adults emerged from dead branches of soapberry, Frio County, Texas. Specimens were collected from the foliage of soapberry, usually within 18 inches of the ground on low growing trees, in the following Texas counties: Bexar, Camanche, Frio, Matagorda, Tarrant, and Uvalde. Collection dates ranged from March 29 to July 19. (**new host record**)

Chrysobothris analis LeConte 1859, Amer. Phil. Soc. Trans. (n.s.) 11:238. Adults emerged from the following hosts in Texas: Texas persimmon, *Diospyros texana* Scheele; soapberry, *Sapindus drummondii* Hook & Arn.; sugarberry, *Celtis laevigata* Willd.; hackberry, *Celtis occidentalis* L.; *Citrus* spp.; and Texas ebony, *Pithecellobium flexicaule* (Benth.). (**new hosts records**)

Chrysobothris beameri Knull 1954, Ohio Jour. Science 54(1):27. One male from a dead branch of skunkbush sumac, *Rhus aromatica* Ait, Chisos Mountains, Brewster County, Texas, April 27.

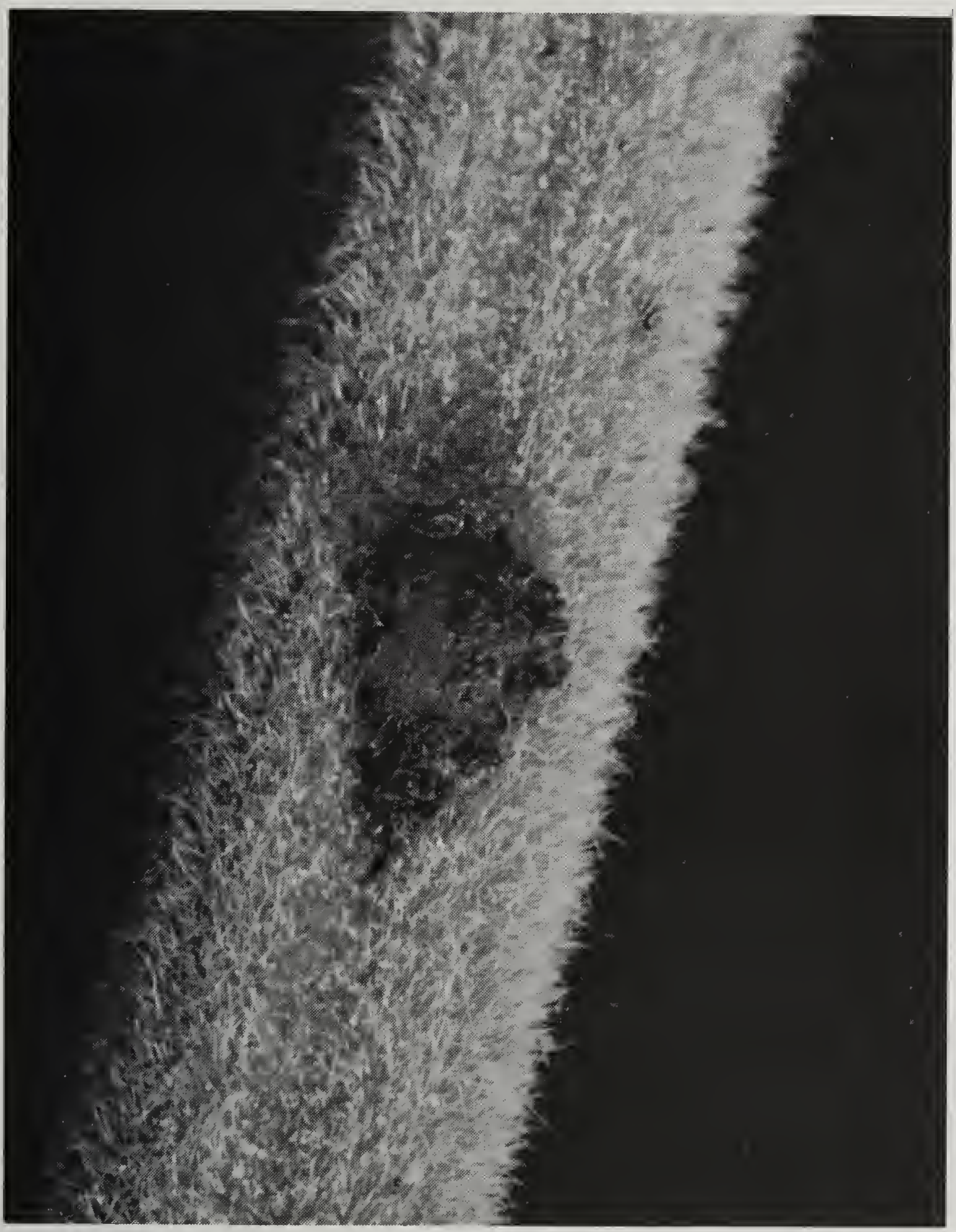

Fig. 2. Egg of *Agrilus obtusus* Horn laid on a stem of *Cassia lindheimeriana*.

ACKNOWLEDGEMENTS

The author wishes to express thanks to Dr. G. H. Nelson (Department of Anatomy, Kansas City College of Osteopathic Medicine) and to Dr. S. G. Wellso (Department of Entomology, Michigan State University) for reviewing the manuscript and helping with identifications.

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WELLSO, S. G. 1973. A new species of *Anthaxia* with notes on other buprestids (Coleoptera: Buprestidae). Coleop. Bull. 27(4):165-8.

* * *

NOTES ON *ANEFLOMORPHA DELONGI* (CHAMPLAIN AND KNULL) (COLEOPTERA: CERAMBYCIDAE)

LESTER L. LAMPERT, JR.

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On 10 September 1975 I caught 6 *A. delongi* in an ultraviolet light trap at the Archbold Biological Station, Highlands County, Florida. While collecting there again during the period 16-29 September 1976, I caught 6 more.

This species was described in 1922 from a male and a female specimen taken by D. M. DeLong at Miami, Dade County, Florida in April 1922 (Champlain and Knull 1922).

A. delongi is apparently very rare. Linsley, in his "Cerambycidae of North America" states: "This species is known to me only by the quoted description" (Linsley 1963).

It is interesting to note that whereas DeLong caught his specimens in April, mine were all caught in September. Although I have collected at the Archbold Station for 2 weeks in April each year since 1973, I have never encountered *A. delongi* during that month.

My thanks to Mr. James E. Wappes for confirming my determination of *A. delongi.*

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* * *

NEW HOST RECORDS AND BEHAVIOR OBSERVATIONS ON FLORIDA CERAMBYCIDAE

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Abstract

Stenodontes dasytomus dasytomus (Say) is recorded from *Casuarina equisetifolia* Forst. and *Bursera simaruba* (L.) Sarg., and *Eburia stigma* (Olivier) from a hardwood for the first time. Observations of *Derancistrus scabrosus* (Gahan) indicate it may be diurnal.

Stenodontes dasytomus dasytomus (Say)

This large prionid attacks a wide range of hardwood trees (Craighead 1950, Linsley 1962, and Baker 1972) and is sometimes of economic importance. In addition to previously listed tree hosts for this beetle, it attacks at least 2 of the tropical hardwoods found in southern Florida.

In Vero Beach, Indian River County, 3 characteristic exit holes of *S. d. dasytomus* were discovered in a dead portion of a green stump of Australian pine (*Casuarina equisetifolia* Forst.) in May 1975, and a dead but intact adult was found in one of the burrows. Adults also were taken from under the bark of a *Casuarina* sp. in West Palm Beach, Palm Beach County, in April, and exit holes have been observed several times in dead Australian pines. The presence of *S. d. dasytomus* in Australian pines, actually deciduous trees despite their common name, should be of interest since the trees, along with several other exotics, are rapidly becoming ". . . a most serious problem in the preservation of native vegetation in South Florida" (Craighead 1971).

Adults, larvae, and pupae of *S. d. dasytomus* have been taken in rotten logs at Matheson Hammock, Dade County. Although most of the logs were too decayed to permit identification, the distinctive, frass-filled burrows of the larvae of this species were found in a small log of gumbo-limbo, *Bursera simaruba* (L.) Sarg., in May 1975. Also, an adult female was taken from under the bark of a gumbo-limbo log on upper Key Largo, Monroe County, on 30 May, 1976. This is another new host record.

Eburia stigma (Olivier)
(Fig. 1)

Linsley (1962) lists only *Pinus caribaea* Morelet as a host for this distinctive species. Long and Lakela (1971) have said that *P. caribaea* does not occur in Florida, the previous records representing misidentifications of *P. elliotti* var. *densa* Little and Dorman. On upper Key Largo on 3 April 1976, I dug a single cerambycid pupa out of the stump of a hardwood tree, possibly mastic, *Mastichodendron foetidissimum* (Jacq.) Cronquinst. When the adult emerged on 18 April 1976, it was determined to be *E. stigma*. This is the first record of *E. stigma* breeding in a hardwood.

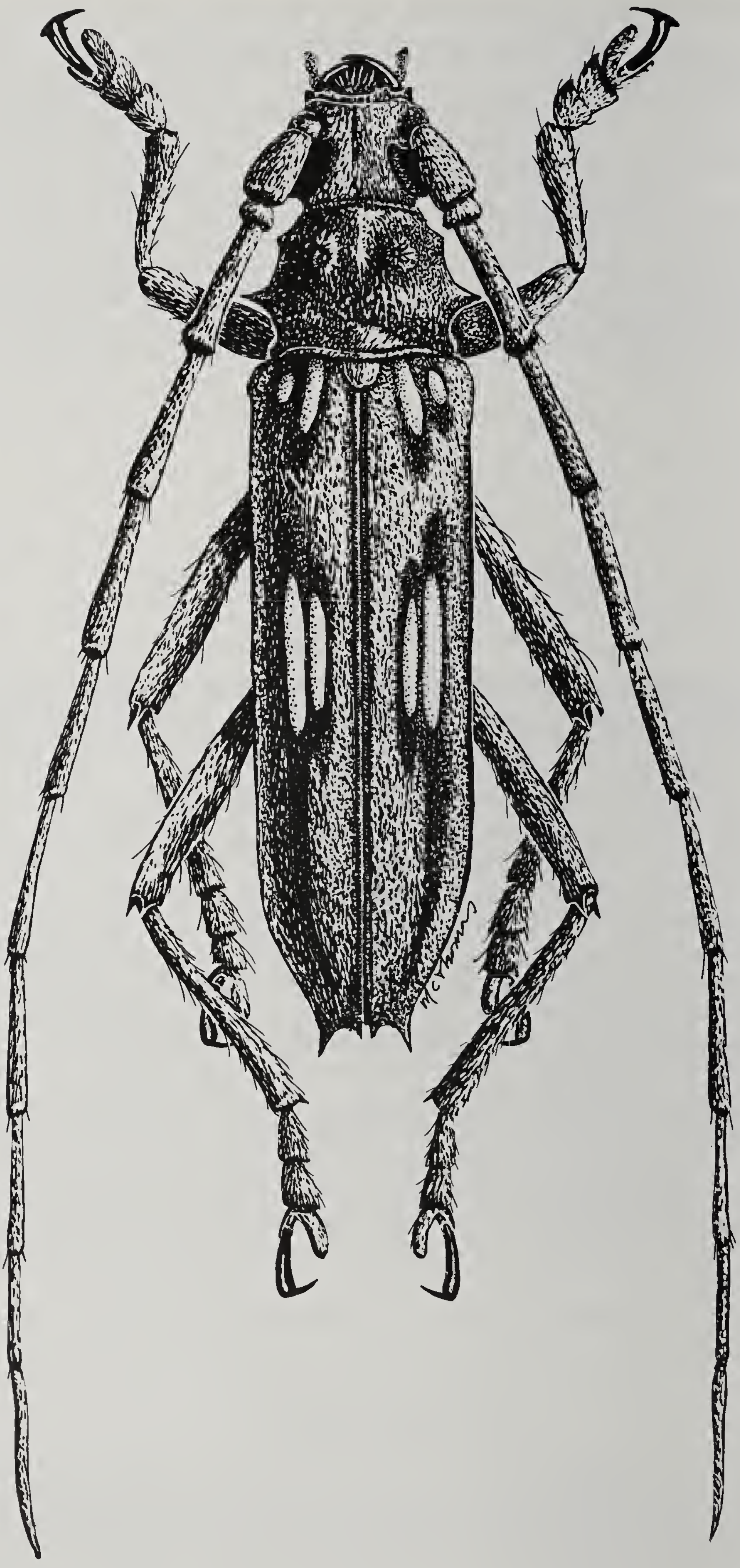

Fig. 1. Habitus of *Eburia stigma* (Olivier), from Key Largo, Florida.

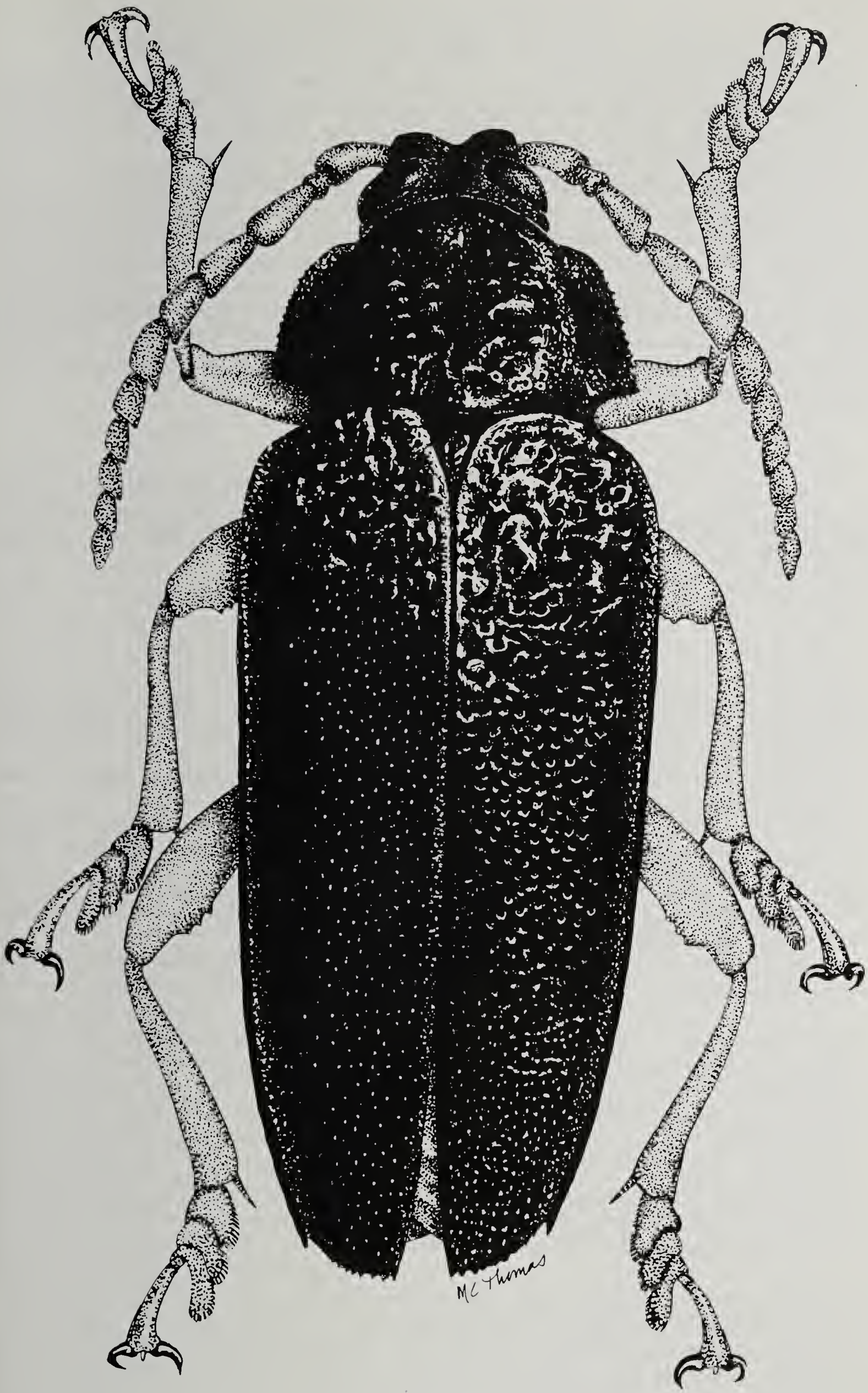

Fig. 2. Habitus of *Derancistrus scabrosus* (Gahan), from Key Largo, Florida.

Derancistrus scabrosus (Gahan)
(Fig. 2)

This species is rarely collected, at least in southern Florida, the only part of the United States in which it occurs, and apparently nothing of its habits have been reported. Howard Frank and I took 2 specimens of this prionid on upper Key Largo on 30 May 1976, and observations indicate that this beetle may be diurnal.

One specimen was first observed crawling very rapidly along the trunk of a small, dead tree during the hottest part of the day. The beetle's black body and bright orange-red legs and antennae, which vibrated constantly as it crawled, made it quite conspicuous. It took flight instantly when the trunk was inadvertently jarred, alighting a short distance away. It was almost buprestid-like in the rapidity of its motions and its willingness to take wing. A second specimen was discovered later in the day, which in the meantime had become quite overcast. The beetle was found clinging to the underside of a broad leaf of a large solanaceous weed and was easily approached and hand-picked from the plant.

ACKNOWLEDGEMENTS

I would like to thank R. Dale Patchett, formerly of the Florida Division of Forestry, for his help in tree identification, and J. Howard Frank, of the Florida Medical Entomology Laboratory, Vero Beach, for his company on collecting trips and his helpful criticism.

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CLARIFICATION NOTES ON TWO FABRICIAN CHRYSOMELID TYPE SPECIMENS (COLEOPTERA: CHRYSOMELIDAE)

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Abstract

The status of the type specimens cited for *Phyllotreta bipustulata* (Fabricius) and *Phyllotreta striolata* (Fabricius) is clarified.

Notes on *Crioceris bipustulata* Fabricius

While checking the types of *Phyllotreta* Chevrolat for my current revision of this genus, I borrowed from the Universitetets Zoologiske Museum of Copenhagen the "type" of *Crioceris 2 pustulata* Fabricius (Fig. 1), given by Zimsen (1964:105) as coleopteran number 1604. This specimen is cited as the type of *Phyllotreta bipustulata* (F.), but it proved to be a species of the genus *Zeugophora* Kunze.

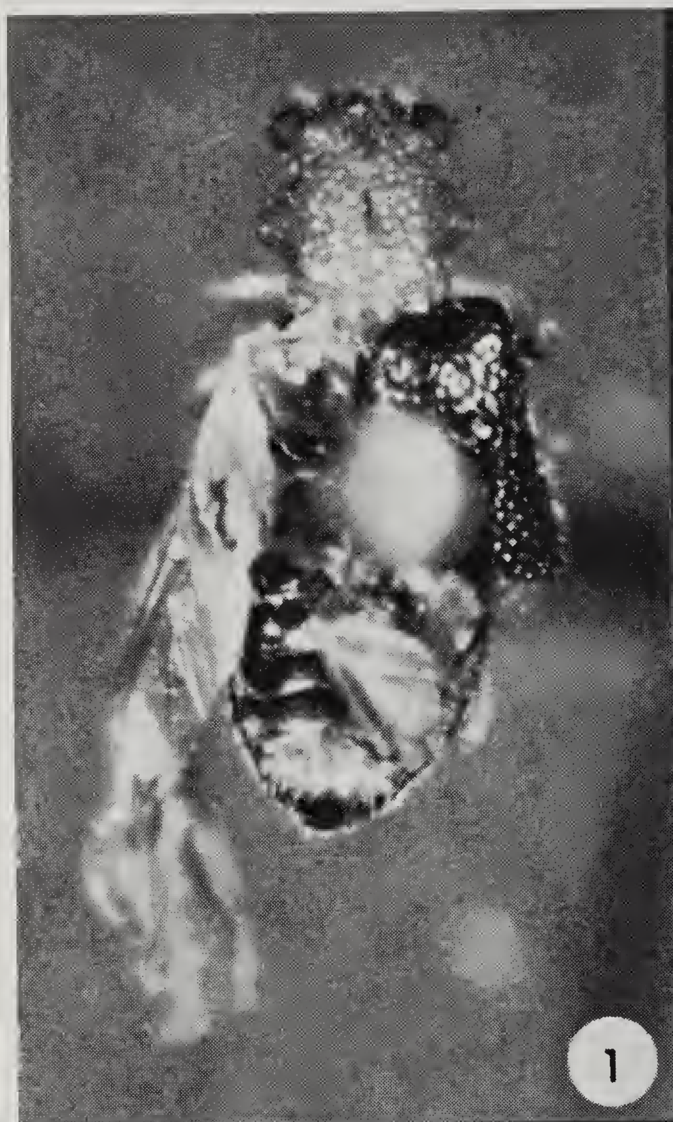
Fabricius' original description (1801a:464, species 73) agrees with what we presently call *P. bipustulata* and so does Olivier's redescription of the Fabrician type (1808a:723-724), with the exception that both authors describe the elytral pale subapical mark as "lunatis" or crescent-shaped. This color pattern description best fits the color variant of *P. striolata* (Fabricius) described as *P. s. discendens* by Weise. However, Olivier's illustration of this specimen (1808b:pl. 5, fig. 97) shows that the apex of this mark is not incurved toward the suture, and this specimen therefore matches *P. bipustulata* as presently understood.

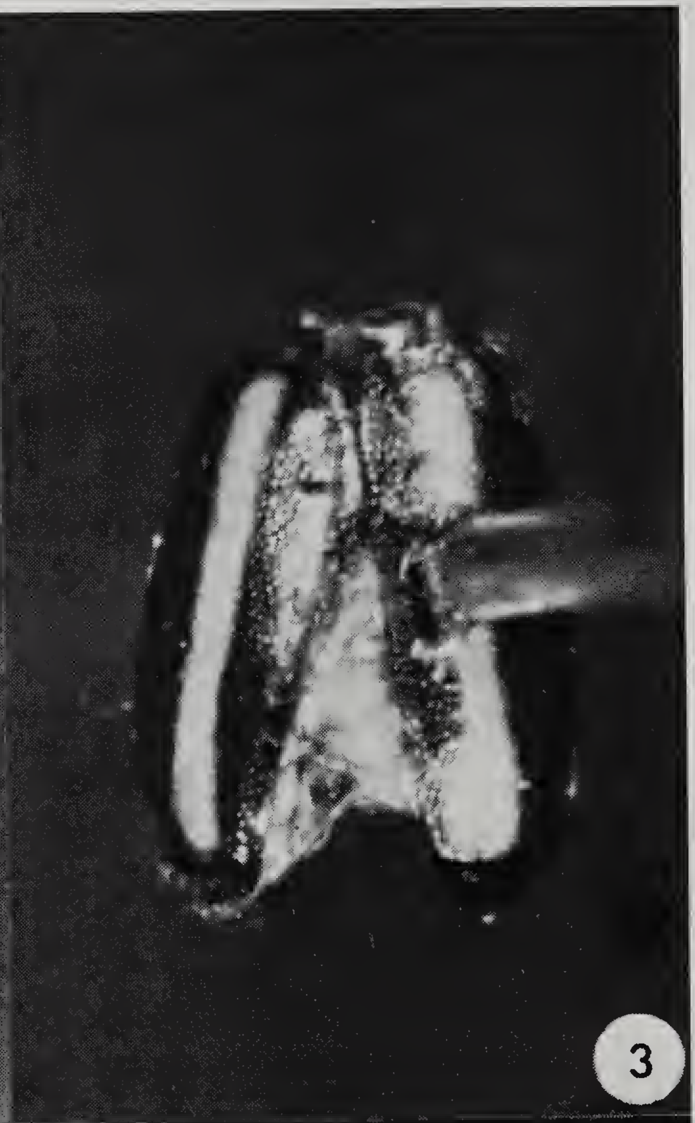
Clavareau in the Junk Catalogue (1913:52) indicated that Fabricius (1801b:40, species 56) also described another species, using the same specific name, in the genus *Clytra*. Clavareau lists this species as being in doubt. The Fabrician original description of *Clytra bipustulata* does not fit either *P. bipustulata* or the "type" sent. Unfortunately, Olivier does not treat *Clytra bipustulata* in his Entomologie. Although there is no check on the identity of this specimen, it does not appear to be involved in the present problem.

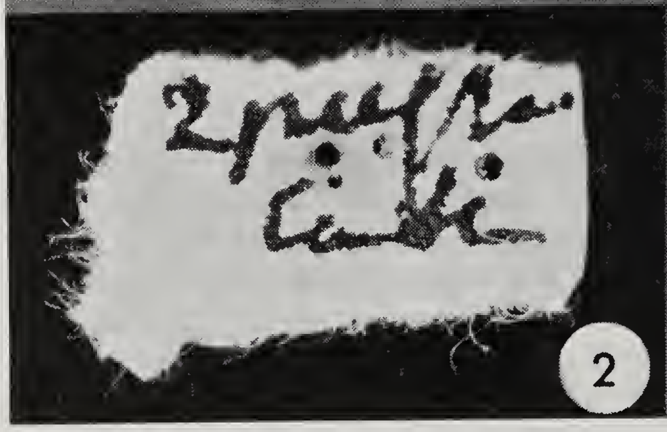
The type locality is given as "Carolinae" and the location of the type as in the Bosc Collection. This suggests that the type locality be restricted to near Charleston, South Carolina (see Blake 1952). Blake (1952) did not find *Crioceris bipustulata* in the Bosc Collection, but she did comment that all specimens were in good condition because "probably all specimens that were not had long since been discarded." The specimen sent from Copenhagen was accompanied by Fabricius' determination label (Fig. 2), a torn piece of light-brown paper with "2 pustulata" written in black ink. There were no other data. This specimen is from the Kiel Collection, which was Fabricius' personal collection, and it is therefore probably not the type specimen he referred to as being in the Bosc Collection.

Based on the "type" sent, the original description, and Blake's observations, it is most probable that the type of *Crioceris bipustulata* F. (1801a:464) has been lost and that this Fabrician determination label has been erroneously associated with another chrysomelid specimen.[1] However, to help eliminate the possibility that the type was still in the collection but unlabeled or mislabeled, I sent a specimen to Sv. G. Larsson and he checked the Fabrician Collection for any similar specimens, but none was found (Larsson 1973). The designation of a neotype has been postponed until the publication of my Ph.D. dissertational revision (Smith 1973).

[1] The "type" sent (female) belongs in the genus *Zeugophora* and is very near *Z. scutellaris* Suffrian. Suffrian's original description (1840:99) fits this specimen except that it is slightly shorter than the stated length and the elytron part present (left and apical half of the right are missing) is brownish black instead of black, and has a metallic luster. However, this specimen does fit within the size range and coloration, except for the metallic luster, of 21 Nearctic specimens of this species which were examined for comparative purposes. Additionally, in running this "type" through Crowson's 1946 key to world *Zeugophora,* it best keys out to *Z. scutellaris.*



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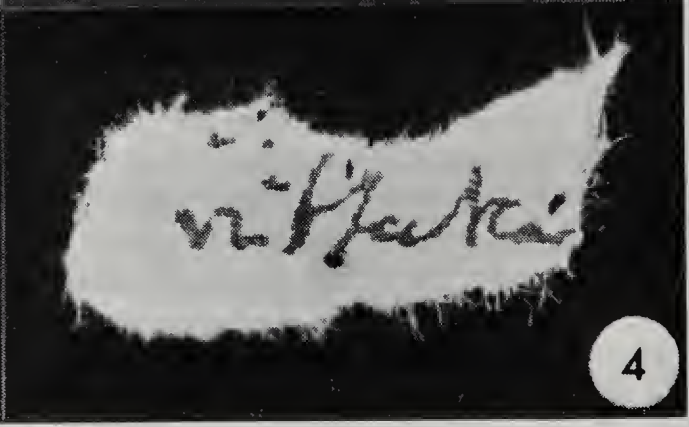

Fig. 1. "Type" of *Crioceris 2 pustulata.*

Fig. 2. Fabrician determination label accompanying "type" of *C. 2 pustulata.*

Fig. 3. "Type" of *Crioceris vittata.*

Fig. 4. Fabrician determination label accompanying "type" of *C. vittata.*

NOTES ON *Crioceris vittata* FABRICIUS

I also borrowed (Fig. 3) the "type" of *Crioceris vittata* Fabricius (1801a:469, species 95); given by Zimsen (1964:105) as coleopteran number 1618. This specimen is cited as the type of *Phyllotreta striolata* (F.); for type clarification see Barber (1947:156-157). However, the specimen sent is not a *Phyllotreta* but, based on my experience (Smith 1970), is most probably *Systena elongata* (Fabricius).

This female specimen has the head and prothorax missing and thus, until the female genitalia are studied, further confirmation of identity is not possible. Fabricius' original description agrees with what we presently call *P. striolata* but, unfortunately, Olivier (1808a, 1808b) did not review and/or illustrate this species when he reworked the Fabrician Collection, so there is no check. The differences between the Fabrician description of *C. vittata* and *S. elongata* are: 1) the size is given as somewhat small (length of *P. striolata* is 1.8-2.6 mm), whereas *S. elongata* (length 2.8-3.9 mm) is of moderate size for a flea beetle; and 2) the elytral stripe is given as incurved toward the suture basally and apically, but not touching apically, whereas in *S. elongata* the stripe is straight basally and only very slightly incurved apically at most.

The type locality of *C. vittata* is given as "Carolinae" and the location as in the Bosc Collection, which suggests that the type locality be restricted to the vicinity of Charleston, South Carolina (see Blake 1952). Blake (1952) did not find *C. vittata* in the Bosc Collection, but she did comment that all specimens were in good condition because "probably all specimens that were not had long since been discarded." The specimen sent from Copenhagen was accompanied by Fabricius' determination label (Fig. 4), a torn piece of light-brown paper with "vittata" written in black ink. There were no other data. This specimen is from the Kiel Collection, which was Fabricius' personal collection, and it is therefore probably not the type specimen he referred to as being in the Bosc Collection.

Based on the "type" sent, the original description, and Blake's observations, it is most probable that the type of *Crioceris vittata* F. (1801a:469) has been lost and that this Fabrician determination label has been erroneously associated with this specimen of a different species of striped flea beetle. However, to help eliminate the possibility that the type was still in the collection but unlabeled or mislabeled, I sent specimens to Sv. G. Larsson and he checked the Fabrician Collection for any similar specimens, but none was found (Larsson 1973). The designation of a neotype has been postponed until the publication of my Ph.D. dissertational revision (Smith 1973).

ACKNOWLEDGEMENTS

I would like to thank Jan Edelmann (for loan of the types) and Sv. G. Larsson (for consultations), Universitetets Zoologiske Museum, Copenhagen; Charles A. Triplehorn (for loan of specimens and reviewing the manuscript), Barry D. Valentine (for taking photographs and reviewing the manuscript), and Donald J. Borror (for reviewing the manuscript), Ohio State University; and Richard E. White (for loan of specimens), SEL, ARS, USDA, c/o U.S. National Museum.

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STUDIES OF THE SUBTRIBE TACHYINA (COLEOPTERA: CARABIDAE: BEMBIDIINI) SUPPLEMENT B: LECTOTYPE DESIGNATION OF *MASOREUS RIDICULUS* SCHAUFUSS AND TRANSFER OF THIS SPECIES TO *POLYDERIS*

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During a recent trip to the Museum für Naturkunde an der Humboldt-Universität in East Berlin, DDR, I was able to examine the type of *Masoreus ridiculus* Schaufuss (1879:552). This supposed *Masoreus* species was described from the Antillean island of St. Thomas and was described as being 1.0 mm in length, hence the name *M. ridiculus,* as no *Masoreus* species are less than about 5.0 mm. Examination of the type, through the kindness of Fritz Hieke, showed that the "ridiculous" thing was the placement of this species in *Masoreus* or the Masoreini for that matter. The beetle is, in fact, a Tachyina (Bembidiini) of the genus *Polyderis,* and is the same species named by Bates (1884:287) five years later as *Lymnastis capito* (see Erwin, 1974:143). Therefore, I take the following action: Lectotype, female, here selected, in HUB (see above); type-locality—St. Thomas, Virgin Islands; *Masoreus ridiculus* Schaufuss = *Lymnastis capito* Bates, **new synonymy.** *L. capito* is really a *Polyderis* species and has nothing to do with *Lymnastis* as I already pointed out (Erwin, 1974). The correct name of the species from St. Thomas is now *Polyderis ridiculus* (Schaufuss), **new combination.**

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OBSERVATIONS ON SOME RARE SCARABAEIDAE MAINLY FROM CALIFORNIA

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There are a number of species of Scarabaeidae from the western states, which are very poorly known or very rarely collected. Many of these have been known only from the type series.

During the past several years, I have accumulated the following information which should be recorded.

Xeropsamobeus desertus (Van Dyke)
(Aphodiinae)

Recent investigation of the sand dune habitat in the Southwestern U.S. and Mexico turned up a number of individuals of this species. In the Glamis area of California, adults of this species have been taken at light and sifted from sand excavated from the base of a partially buried Palo Verde Tree (*Cercidium floridum* Benth.). At sand dunes near Puerto Penasco, Sonora, specimens were collected under a moist, partially dry cow chip. In both circumstances, the beetles were in moist sand. Specimens examined by me bear the following data:

U.S.A., CALIFORNIA. *Imperial Co.*: Glamis IV-22-1971 (4); 3 mi. N.W. Glamis III-24-1972 (2); 3.5 mi. N.W. Glamis III-10-1973 (4). *Riverside Co.*: Blythe, I-10-1942 (1) (CAS); XI-1941 (1) (CAS).

MEXICO, *Sonora.* 50 mi. S.W. Sonoyta (near Puerto Penasco) III-12-1973 (1); 10 mi. N. Ciudad Sotelo III-13-1973 (2).

Pachyplectris laevis LeConte
(Hybosorinae)

This rare species has been frequently encountered at night at the crests of sand dunes near Glamis in early spring. Fragments of dead individuals have been taken from the burrows of Kangaroo Rats (*Dipodomys merriami* Mearns and *D. deserti* Stephens). Other individuals were taken at lights. Specimens examined include:

ARIZONA. *Gila Co.*: Roosevelt Lake V (1).

CALIFORNIA. *Imperial Co.*: Glamis IV-22-1971 (1); 3 mi. N.W. Glamis, III-4-1972 (1), III-24-1972 (2), IV-15-1972 (1), IV-12-1973 (1); 3.5 mi. N.W. Glamis III-10-1973 (21). *Riverside Co.*: Hopkins Well, IV-16-1958 (1), V-16-1958 (1). *San Bernardino Co.*: Yermo IV-9-1940 (1). *San Diego Co.*: Borrego, III-31-1953 (5), IV-30-1954 (1); Mason Valley III-27-1928 (1).

UTAH. *Washington Co.*: Santa Clara Creek, near Ivins IV-18-1962 (1).

Serica egregria Dawson
(Melolonthinae)

I collected a number of examples of this species, mixed with 4 or 5 other species of the genus, at California, Los Angeles County, South Fork Public Camp (San Gabriel Mountains), in July, at blacklight.

Diplotaxis corbula Vaurie
(Melolonthinae)

Blacklights placed upon sand dunes have taken this species at: CALIFORNIA. *Imperial Co.*: 2 mi. N.W. Glamis, II-27-1972 (1), IV-23-1970 (2), V-5-1970 (2); 3 mi. N.W. Glamis III-4-1972 (3), III-24-1972 (2), IV-9-1972 (9), IV-12-1969 (4), IX-15/16-1972 (14); Regina IV-22-1971 (1), VII-4-1971 (15).

Phobetus robinsoni Saylor
(Melolonthinae)

This species has been previously known from only the type specimens (2 males). I have seen additional specimens with the following data:
CALIFORNIA. *San Diego Co.*: Jacumba, IV-4-1971 (9).

Dinacoma marginata Casey
(Melolonthinae)

In the Museum of Comparative Zoology, I recently found a female of this species collected at Palm Springs. Females of this genus were previously unknown (see Hardy 1974). The top of the head is damaged, and the posterior tarsi are missing, otherwise the specimen is in good condition. The female differs from the male as follows: length 20 mm., generally less squamose and with a much swollen abdomen. Head apparently more gibbose, antennal club reduced in size, anterior tibiae more massive, distinctly tridentate. Prothorax broader, more hirsute. Posterior tibial apex explanate.

Parabyrsopolis arizonae Ohaus
(Rutelinae)

Paraeroda rufobrunnea Casey. NEW SYNONYMY

I indicated in an earlier paper (Hardy 1971) that these 2 names might be synonymous. An examination of the types of both indicates this is the case. The type of *P. arizonae* Ohaus (a female, 30 mm. in length) bears the following labels: (1) "Arizona", (2) "female", (3) (mouth parts on a card), (4, Red) "Typus!", (5, Red) "Parabyrsopolis arizonae Ohaus", all labels handwritten. The type of *P. rufobrunnea* Casey (a female 30.5 mm.) bears the following labels: (1, press printed) "Huachucha Mts. Ariz. July 1905", (2, press printed) "Casey bequest 1925", (3, Red; press printed) "Type USNM 48553", (4, handwritten) "Paraeroda rufobrunnea Csy."

Additional specimens examined:
U.S.A., ARIZONA. Huachucha Mts. (w/o date) (6), VIII-1-1967 (3); Carr Cyn. VIII--19 (1), VIII-7-1924 (3); Ft. Huachucha (w/o date) (1); Parmerlee (w/o date) (1), VII-28-1904 (1).
MEXICO, CHIHUAHUA. Cuiteco, VII-3-1968 (1).

Phileurus illatus LeConte
(Dynastinae)

Leach (1935) reports this species as "exceedingly rare" in California, and reports a specimen from San Bernardino Co., California. I recently collected a specimen at light:
CALIFORNIA. *Imperial Co.*: 3 mi. N.W. Glamis, IX-15/16-1972 (1).

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SOME OBSERVATIONS ON THE FINE-STRUCTURE MORPHOLOGY OF *XENOS PECKII* (COLEOPTERA: STYLOPIDAE)

Gene Kritsky[1], Douglas W. Wells[2], and José A. Mari Mutt[3]

Abstract

The fine-structure morphology of *Xenos peckii* (Coleoptera: Stylopidae) was studied with the scanning electron microscope. Details of antennae, eyes, and elytra are illustrated.

The Stylopidae are small beetles which parasitize some species of Hymenoptera, Homoptera, Hemiptera, Orthoptera, and Thysanura. *Xenos peckii* Kirby is a parasite of the wasp *Polistes fuscatus.* A preliminary study of fine-structure morphology was made from a series of *X. peckii* collected from these wasps in Indianapolis, Indiana.

Figure 1 shows the entire head of a male of *X. peckii.* This species has 4-segmented antennae and large raspberry-like compound eyes. The mouth parts are reduced, with the mandibles appearing smooth and pointed. Below the mandibles are the maxillary palpi.

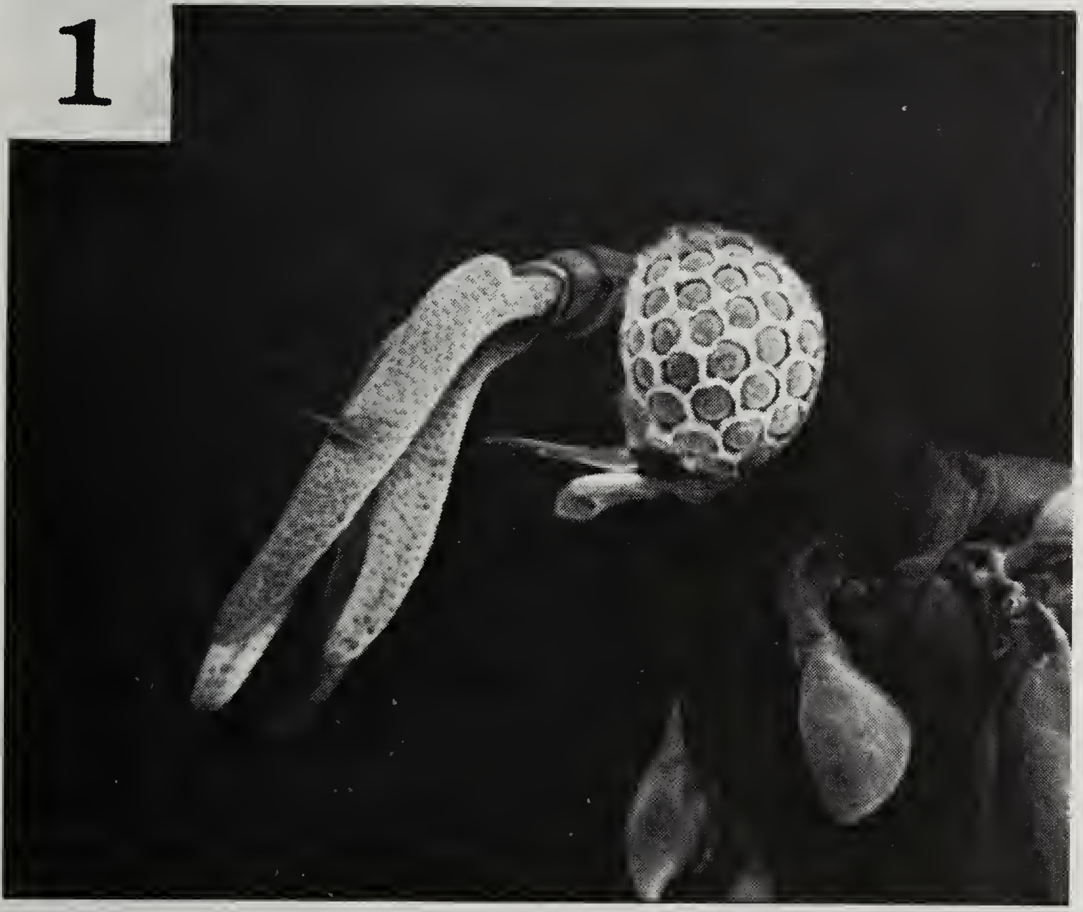

Fig. 1, *Xenos peckii,* head and antenna.

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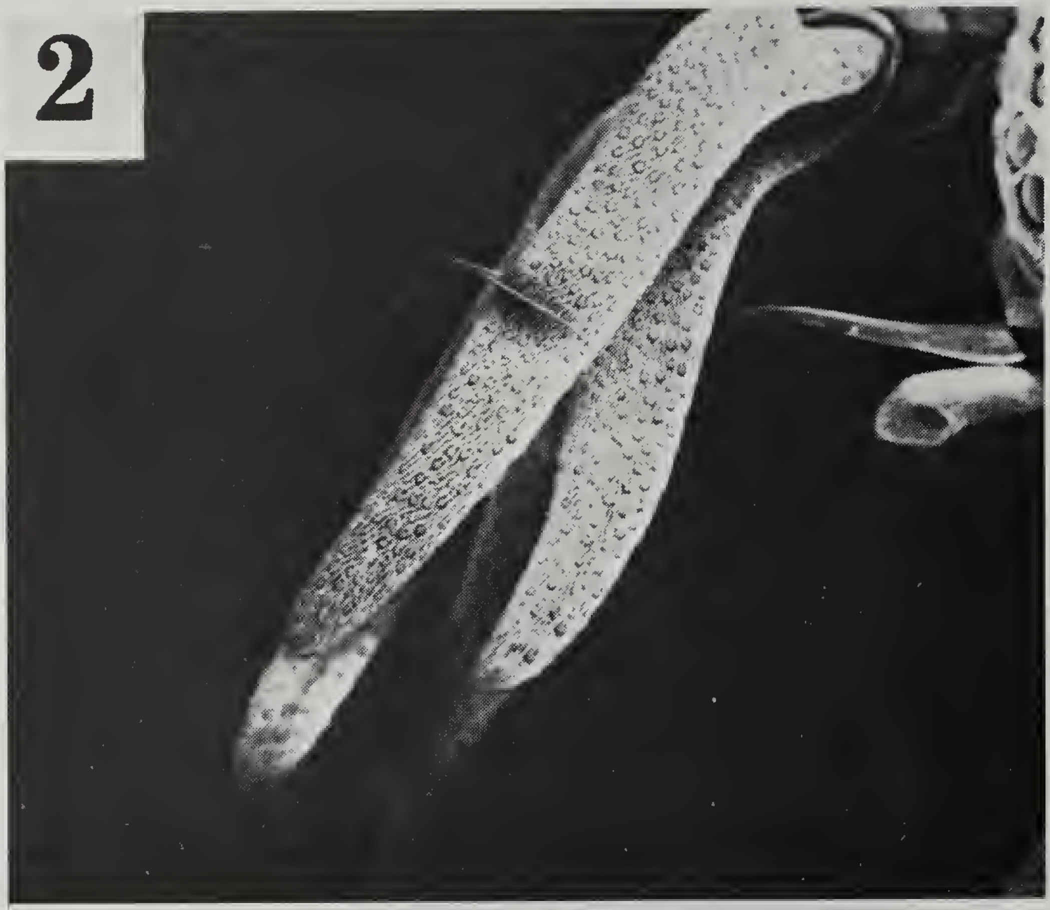
[2] Indianapolis, IN.

The flabellate antennae (fig. 2) are covered with large sensilla basiconica (fig. 3). Kinzelbach's fine work (1966) showed that species of *Xenos* have 3 nerve cells innervating each basiconic peg.



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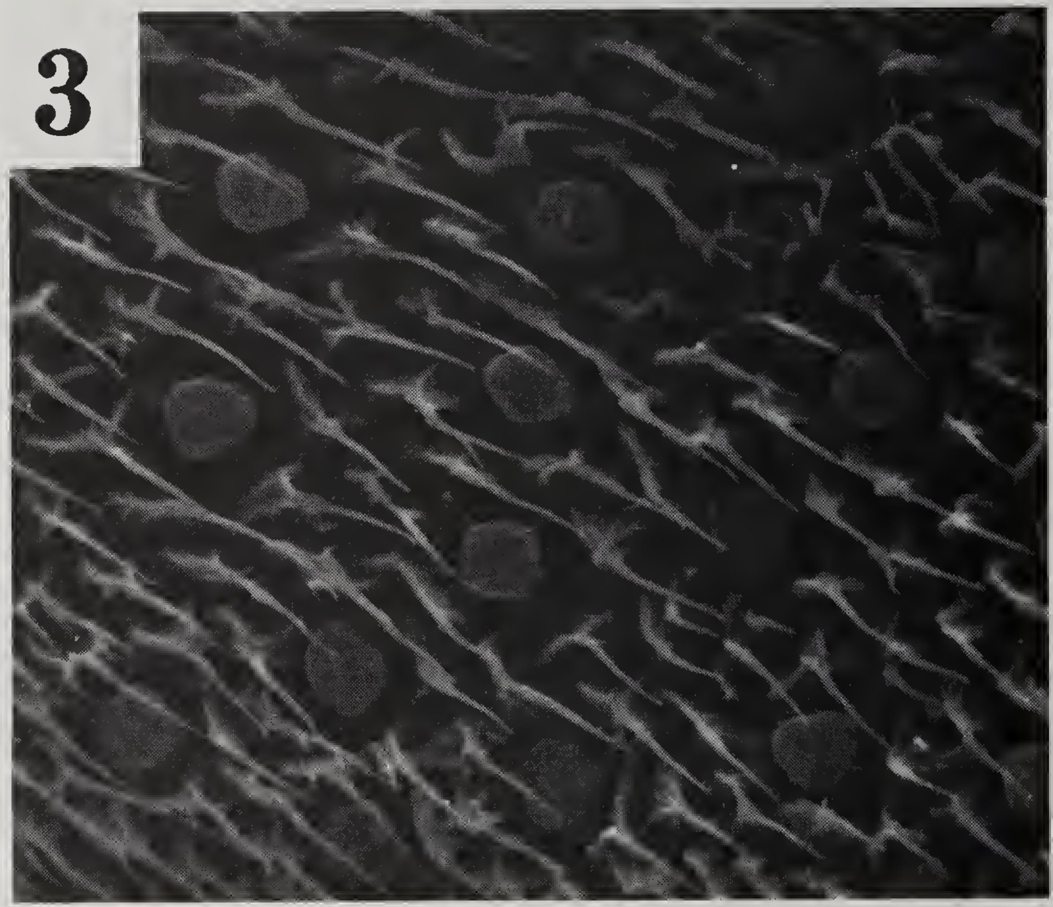

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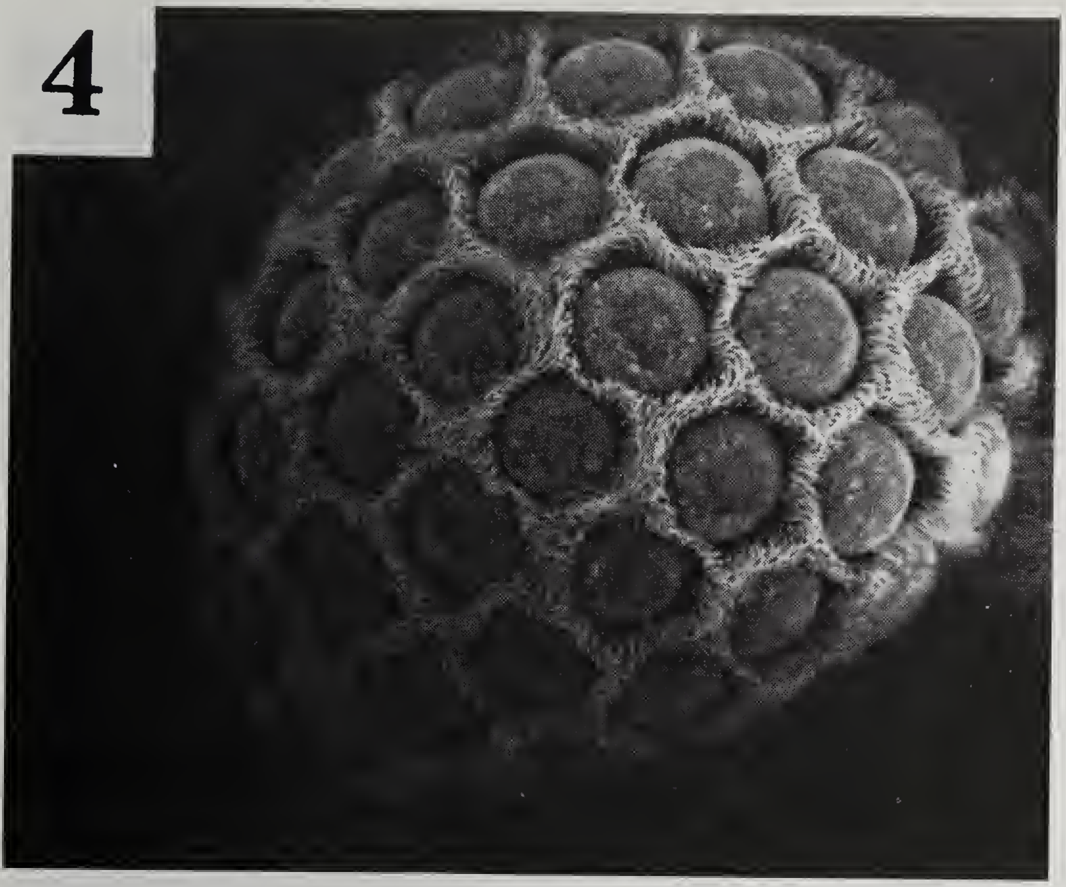
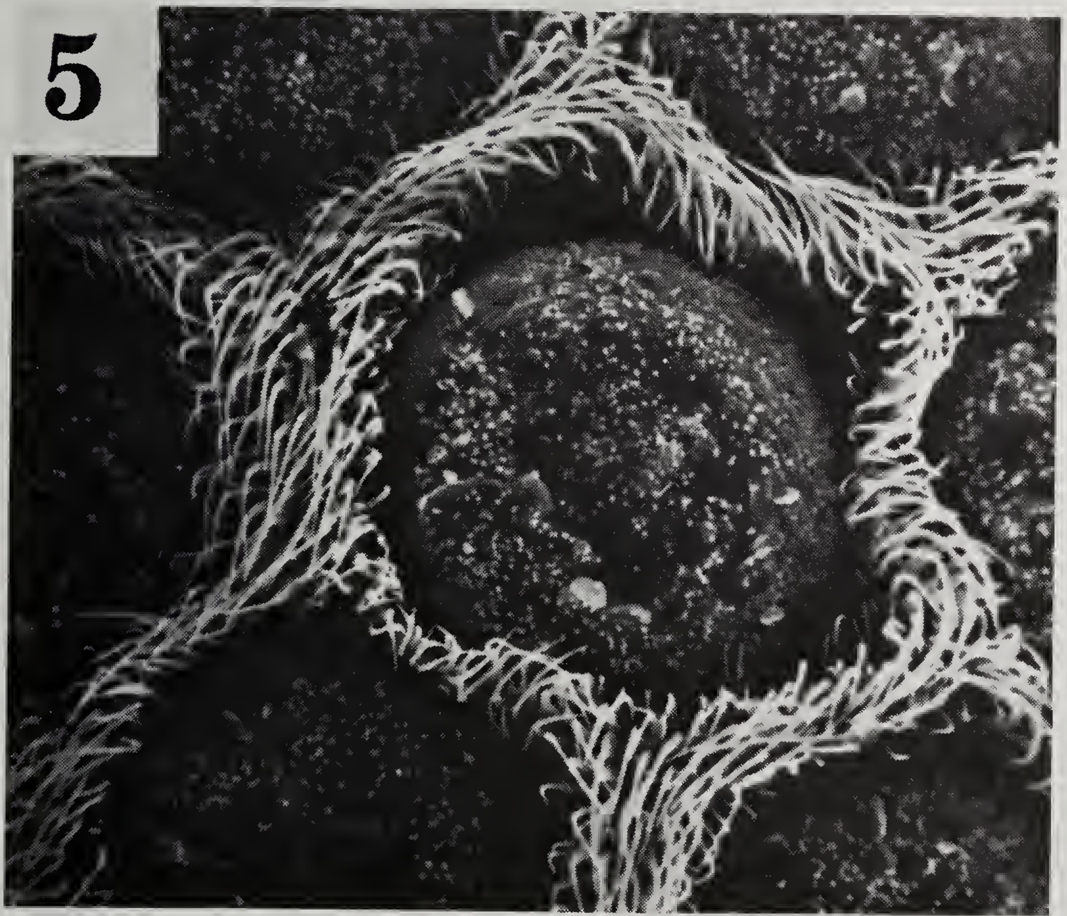
Figs. 2-3, *Xenos peckii*: 2) antenna; 3) sensilla basiconica on antenna.

The eyes (fig. 4) are composed of 40 to 50 ommatidia ranging from .045 to .050 mm in diameter. Each ommatidium (fig. 5) is surrounded by a dense group of microtrichia. The microtrichia may have elaborate forms, some having 2 or 3 peaks at the apex.





Figs. 4-5, *Xenos peckii*: 4) compound eye; 5) ommatidium.

The forewings or elytra are reduced, paddle-shaped structures. Each is covered with microtrichia (fig. 6) which like those around the ommattidia may also have more than one peak.

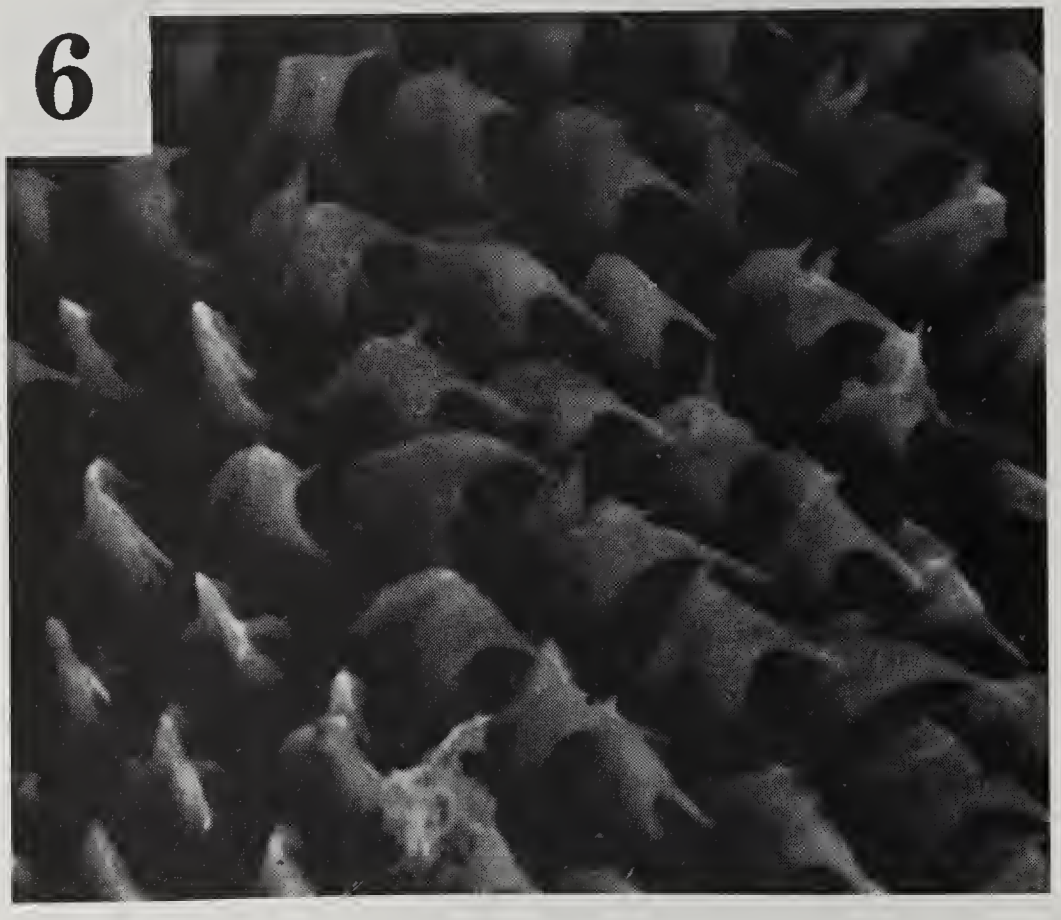


Fig. 6, *Xenos peckii,* microtrichia on elytron.

An attempt was made to examine the chromosomes and sperm of *X. peckii,* but the material collected was too far into spermatogenesis for meiosis to be observed. It is known that *X. peckii* has 16 chromosomes (Schrader 1924). The testes of *X. peckii* were large and were easily dissected. The sheath was unpigmented, and the sperm ranged in size from 8 to 16 microns in length.

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NOTES ON THE LONG-HORNED BEETLES OF VIRGINIA, PART IV (COLEOPTERA: CERAMBYCIDAE)

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Abstract

The ranges and Virginia records for 13 species are presented. Ten species are strictly in the southwestern section, 2 are in the western mountains and 1 is common to both areas of the state.

In preparing a paper on the Long-Horned Beetles of Virginia, I have noticed that several species are only found in the southwest portion of the state. This area, noted for its mountains and lush greenery, is the southern extremity of 5 species of our Cerambycidae, the northern extremity of 2, and the eastern extremity of 2 (Fig. 1). Two of the species listed are not in the southwestern section but are in the mountainous region and are unique records for the state. For the loans and gifts of material I would like to thank George Vogt (USNM), Michael Kosztarab (VPI&SU), Richard Hoffman (Radford, VA), J. B. Karren (Price, UT), Robert Surdick (Bethel Park, PA) and Donald Wilson (Orono, ME). Following are the ranges of the species and records in Virginia.

Parandra (Archandra) polita (Say)

This uncommon species has been taken in Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, Illinois, Ohio, and Virginia(?). Linsley (1962a) reports this species from the Virginia, Kentucky, Tennessee corner. I have no specific record in Virginia.

Michthisoma heterodoxum LeConte

This elusive, ant-like species has been taken in Georgia, South Carolina, and North Carolina. *Virginia*: Mountain Lake, June.

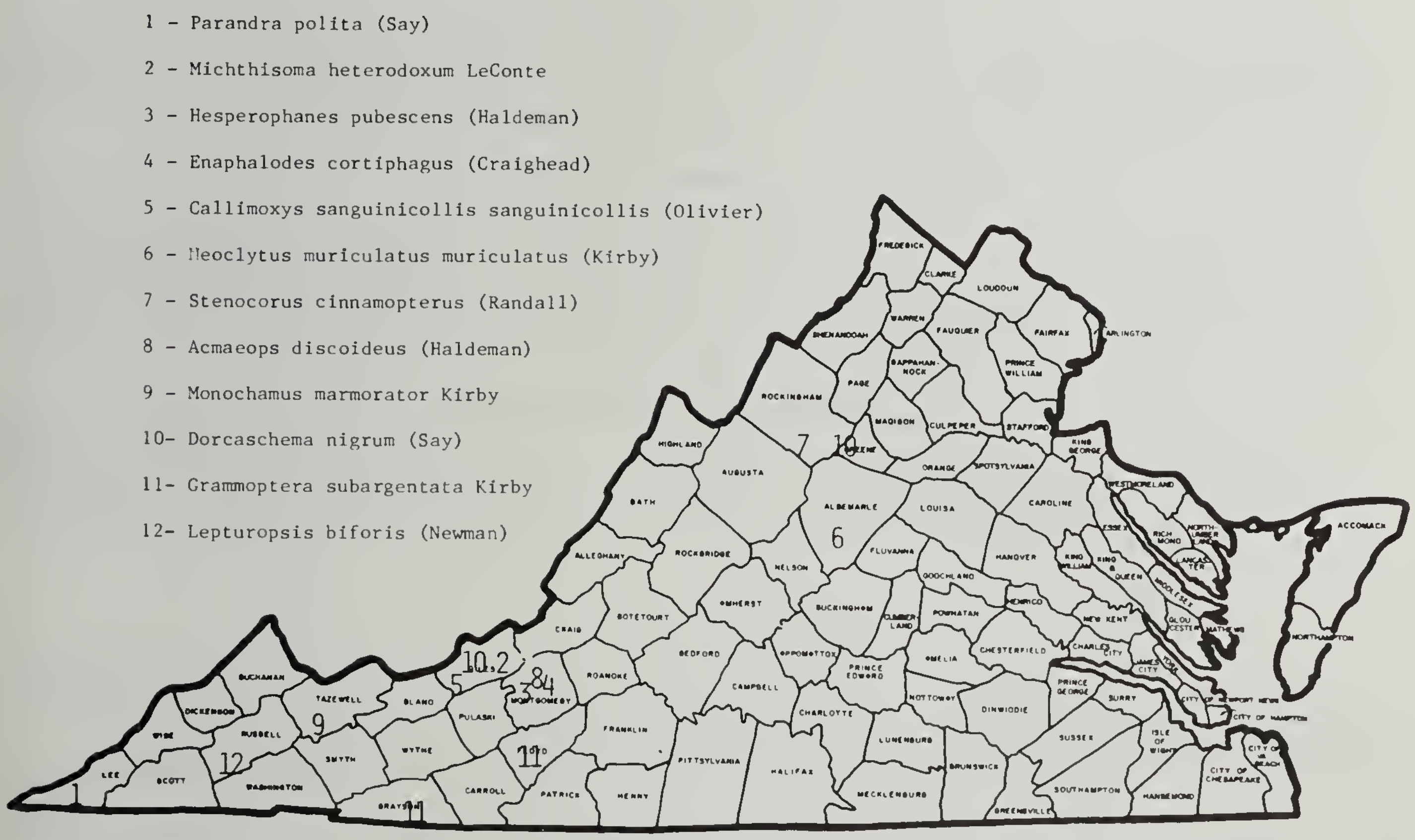
1 - Parandra polita (Say)
2 - Michthisoma heterodoxum LeConte
3 - Hesperophanes pubescens (Haldeman)
4 - Enaphalodes cortiphagus (Craighead)
5 - Callimoxys sanguinicollis sanguinicollis (Olivier)
6 - Neoclytus muriculatus muriculatus (Kirby)
7 - Stenocorus cinnamopterus (Randall)
8 - Acmaeops discoideus (Haldeman)
9 - Monochamus marmorator Kirby
10- Dorcaschema nigrum (Say)
11- Grammoptera subargentata Kirby
12- Lepturopsis biforis (Newman)
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Fig. 1. Distribution records of some Virginia cerambycids.

Hesperophanes pubescens **(Haldeman)**

This uncommon species is native to the northern midwest east to Ohio, New York, Pennsylvania, Connecticut, and Massachusetts, and spot collections in Georgia and Alabama. *Virginia*: Blacksburg, 28-VII-1970, black-light trap.

Enaphalodes cortiphagus **(Craighead)**

This rare species ranges thru Illinois, Ohio, Kentucky, New York Pennsylvania and New Jersey and is known from two locations in Arizona. *Virginia*: Blacksburg, 23-V-1914.

Callimoxys sanguinicollis sanguinicollis **(Oliver)**

Linsley (1963) reports this species as native to eastern North America. *Virginia*: Mountain Lake.

Megacyllene decora **(Olivier)**

This beautiful species has been taken in Alberta, Manitoba, Indiana, Kansas, Texas, North Carolina, Georgia, Alabama, South Dakota, Nebraska, New Mexico, and New York. An old undated specimen in my collection reads "S. W. Virginia".

Neoclytus muriculatus muriculatus **(Kirby)**

This small species has been taken in Canada (all southern provinces), Maine, Michigan, North Dakota, New Mexico, Utah, South Dakota, Wyoming, Colorado, Washington, Oregon, Idaho, and New Hampshire. *Virginia*: Crozet, 20-III-1969.

Stenocorus cinnamopterus **(Randall)**

Linsley and Chemsak (1972) record this species from the Northeastern states, south to Georgia, thru Tennessee and Ohio to Kansas. *Virginia*: Timberville, 14-V-1967.

Acmaeops discoideus **(Haldeman)**

This small species ranges thru eastern North America. *Virginia*: Blacksburg, 23-V to 23-VI-1970, *Pinus virginiana*.

Monochamus marmorator **Kirby**

Dillon & Dillon (1941) record this uncommon species from Quebec, Ontario, Maine, New Hampshire, Michigan, Minnesota, North Carolina, Tennessee, and Virginia. *Virginia*: Griffith Mill 4-IX-1935.

Dorcaschema nigrum **(Say)**

Dillon & Dillon (1946) record this species from New York, New Jersey, Pennsylvania, Maryland, Virginia, Illinois, Kansas, Michigan, Wisconsin, Texas, and Mexico. *Virginia*: Mountain Lake; and Skyland, 26-VI-1936, *Hicoria*.

Grammoptera subargentata **Kirby**

Swaine and Hopping (1928) record this species from British Columbia, Alberta, Manitoba, Ontario, Quebec, Ohio, and Pennsylvania. I am sure the range is more extensive but our 2 *Virginia* locations should be southern records: Buffalo Mt. (Floyd Co.), 11-VII-1970; and Mt. Rogers, 17-VI to 28-VII.

Lepturopsis biforis **(Newman)**

Swaine and Hopping (1928) record this species from Ontario, Quebec, New York, Massachusetts, and Pennsylvania. I also have material from Maine. *Virginia*: Russell County, 5-VII-1961.

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* * *

A NEW RECORD FOR *COPRIS HOWDENI* MATTHEWS AND HALFFTER (COLEOPTERA: SCARABAEIDAE)

LESTER L. LAMPERT, JR.

17 Hillview Circle, Asheville, NC 28805

Copris howdeni is a rare dung beetle previously known only from Florida (Woodruff 1973). On 1 June 1973, while collecting in the vicinity of McClellanville, Berkeley County, South Carolina, I took 3 *C. howdeni* in an ultraviolet light trap.

My tentative identification of these beetles was confirmed by O. L. Cartwright of the Smithsonian Institution. In making his determination Cartwright compared these scarabs with a single specimen from the Smithsonian collection, labelled *Copris cartwrighti* Robinson, taken by R. Peters at Charleston, Berkeley County, South Carolina in May 1944. Cartwright found that this specimen had been incorrectly identified and that it was actually *C. howdeni.*

In light of the above, the *C. howdeni* taken by Peters constitutes a new record for South Carolina. The beetles taken by me serve to confirm that this occurrence was not accidental.

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—Paul P. Shubeck

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MALE GENITALIA OF SOME CURCULIONOIDEA (COLEOPTERA): MUSCULATURE AND DISCUSSION OF FUNCTION

Wayne E. Clark

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Washington, D.C. 20560

Abstract

The male genital complex and associated musculature are described for 5 different species of Curculionoidea.

The genital complex consists of an intromittent organ, the median lobe with its apodemes, the median struts, and a tegmen and spiculum gastrale on which the muscles which protract and retract the median lobe have their origins. Associated with the genital complex are tergum VIII and abdominal sterna VII and VIII on which muscles moving the tegmen and spiculum gastrale have their origins. Modifications in the structure of the spiculum gastrale and its connections to the tegmen are associated with changes in the function of homologous muscles.

Introduction

The impetus for this study was observation of major differences in the structure of some parts of the male genital complex in 2 groups of weevils in the tribe Tychiini (*sensu* Clark *et al.* (1977)). In order to determine homologies of these parts and to determine which of the different expressions were plesiotypic (primitive) in Tychiini, genitalia of several representatives of the superfamily Curculionoidea were examined. The following 5 species were studied in detail and form the basis of discussion: *Arrhenodes minutus* (Drury) (Brentidae), *Curculio victoriensis* Pierce (Curculionidea: Curculioninae), *Scyphophorus acupunctatus* Gyll. (Curculionidae: Rhynchophorinae), *Tychius tectus* LeConte, and *Sibinia suturalis* (Schaeffer) (Curculionidae: Tychiinae). The first 3 were selected in part because of availability of specimens which could be used for dissection. *Tychius* and *Sibinia* represent 2 major groups in the tribe Tychiini.

In all, the taxa studied represent only 2 of the 9 families of Curculionoidea recognized by Crowson (1967). One of Crowson's families, Curculionidae, includes taxa which many have preferred to recognize as separate families, the Scolytidae and Platypodidae. One author with such preference, Wood (1973), presents evidence which he interprets to indicate the existence of 3 major groups of Curculionoidea: (1) taxa with 2 gular sutures, entire or incomplete (Belidae, Anthribidae, Nemonychidae, Oxycorynidae, and Proterhinidae); (2) those with 1 gular suture but with pregular sutures (Scolytidae and Platypodidae); and (3) those with 1 gular suture and no pregular sutures (Brentidae, and Crowson's Apionidae, Attelabidae, and Curculionidae). The taxa examined in the present study all belong to the 3rd group. These have been compared, however, with published descriptions and illustrations of members of the 2nd group. More representatives of the 3rd group, as well as members of the 1st group, need to be examined and compared with members of the 2nd group and with each other, with the objective of recognition of synapomorphies within the entire superfamily. This is beyond the scope of my initial objective, and no hypotheses about phylogenetic relationships of major taxa within Curculionoidea are proposed here. Interpretation of my observations as related to phylogeny within the tribe Tychiini will be discussed in a paper dealing with the phylogeny and classification of species of the genus *Sibinia* (in preparation).

Literature pertaining to the male genital complex of Coleoptera is not extensive. Hieke (1966) presents the most comprehensive bibliography on the subject that I have seen. Several workers have dealt primarily with Curculionoidea, or have included representatives of the group in their studies. I have compared my observations with those made by Burke (1959), *Anthonomus grandis* Boh. (Curculionidae: Anthonominae); Muir (1919), *Rhynchophorus ferruginous* (Curculionidae: Rhynchophorinae); Hieke (1966) *Liparus glabrirostris* Kust., (Curculionidae: Hylobiinae); Hopkins (1911) *Pissodes* sp. (Curculionidae: Pissodinae) and (1915) *Dendroctonus valens* LeConte (Scolytidae) and *Crossotarsus lecontei* (Platypodidae). Reference to these genera in the following discussion is to these sources rather than direct observations by me. I also consulted the works of Kingsolver (1970) on Bruchidae, Evans (1961) on Cryptophagidae, and Pu (1938) on several families, particularly Cerambycidae, in an attempt to determine homologies of muscles. Probable homology of muscle bands is listed in Table 1.

Terminology is that of Sharp & Muir (1912) which, as Kingsolver (1970) pointed out, is more widely accepted among coleopterists than other systems which have been proposed. Tuxen's (1970) glossary may be consulted to determine correlations with other terminologies. Muscle bands are herein designated by numbers which correspond to those used by Burke (1959). Other workers have referred to muscle bands by names denoting their functions. This would lead to confusion in the present paper as some homologous muscle bands have different functions in different Curculionoidea.

Genital preparations were made by dissecting some specimens preserved in 70% ethyl alcohol, some pinned specimens, and some fresh specimens treated with a solution developed by Weaver and Thomas (1956). Specimens preserved in alcohol proved to be most satisfactory for study of musculature. Dry specimens were softened in hot water. When only sclerotized parts were desired a hot potassium hydroxide solution was used to dissolve soft tissue. All observations and drawings were made of specimens immersed in glycerin.

Abbreviations used in figures 1-15 are: genital muscles 1-10 (GM-1-10); basal piece of tegmen (bpt); lateral lobes of tegmen (ll); median lobe (ml); median struts (ms); pseudo-tegmen (pt); spiculum gastrale (sg); sternum 8 (SVIII); tegmen (t); tegminal strut (ts); tergum 8 (TVIII).

General Morphology

A brief description of the sclerotized and membranous structures of the genital complex and a discussion of some of their modifications is essential to an understanding of their functions and relationships. For a more detailed description see Burke (1959) and Sharp (1918). Only those structures and muscles involved in protrusion and retraction of the median lobe were studied.

Table I

Probable Muscle Homologies

Clark	Burke	Hieke	Muir	Hopkins	Kingsolver	Pu	Evans
GM-1	GM-1	M.Phb.ph.ap.	d	e1	MLV(pars)	47	PEP
GM-2	GM-2	M.Phb.ph.ap.?	absent	e1	MLV(Pars)	54	isc
GM-3	GM-3	M.phb.endoph.	c	e2	MLV(pars)	48	PER
GM-4	GM-4	M.terg.ap.phb.(pars)	--	--	tr	52	TER
GM-5	GM-5	M.terg.ap.phb.(pars)	--	--	tr?	52?	TED
GM-6	GM-6	M.Urost.phb.	b	e3	tp	50	tepa
GM-7	GM-7	M.antec.uron.lat.VIII	a(pars)	--	sds	57?	ssp
GM-8	GM-8	M.antec.uron-medVIII	a(pars)	--	sps	57?	ssd
GM-9	--	M.antec.Urost.VIII	a(pars)	e3	svs	55or56	ssv
GM-10	--	M.Urost.terg.ap.	--	--	--	55?	tsp

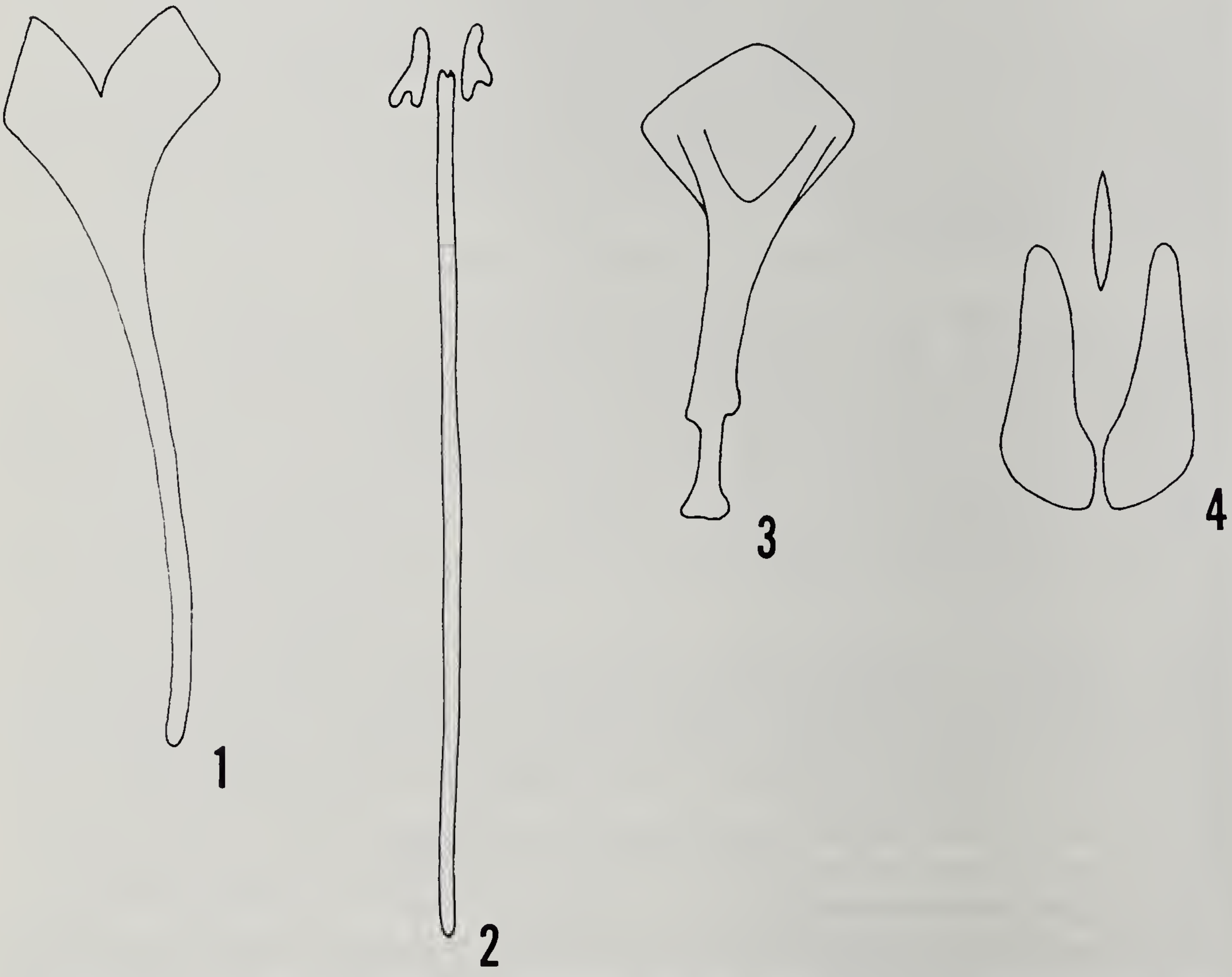
The male intromittent organ in Curculionoidea is called the median lobe (ml, Figs. 6, 7, 9, 11, 13, 14, 15). It is composed of a more or less flattened and curved tube with a pair of elongate, laterobasal apodemes called the median struts (ms, Figs. 6, 8, 11, 13, 14, 15) which project anteriorly into the abdomen. In its resting position the median lobe lies in the abdomen horizontal to the long axis of the body. Its structure is essentially the same in all of the forms observed except in Platypodidae in which there are no true struts (Sharp 1918).

Muscle bands involved in protraction and retraction of the median lobe insert on the tegmen and on the spiculum gastrale. The tegmen consists of a basal piece (bpt, Fig. 10) which lies ventral to the median lobe and forms a complete or partial ring through which the median lobe passes, and a pair of lateral lobes (ll, Fig. 7) which arise on the dorsal portion of the ring and extend posteriorly in the body dorsal and lateral to the median lobe. The basal piece usually has a ventral apodeme, the tegminal strut (ts, Fig. 7). In Curculionoidea, the lateral lobes are often absent and the ring formed by the basal piece may be membranous dorsally (see Morimoto 1962 and Clark *et al.* 1977). In *Curculio* and *Scyphophorus* the basal piece forms a nearly complete sclerotized ring. Lateral lobes are present in *Arrhenodes* and *Anthonomus.* In *Tychius, Sibinia,* and *Crossotarsus,* the basal piece and tegminal strut form a distinct Y-shaped structure which lies ventral to the median lobe. The arms of the Y are connected by membrane forming a ring through which the median lobe passes. The tegminal strut is very short in *Liparus* and absent in *Dendroctonus.* Only the basal piece and its strut are involved in muscle attachment.

Some significant modifications were noted in the structure of the spiculum gastrale (sg, Figs. 6, 7, 9, 10, 11, 14, 15). This structure is usually considered to be a remnant of the 9th abdominal sternum in Coleoptera, although some studies do not bear this out. Evans (1961) discussed the evidence and cited pertinent references.

In most Curculionoidea the spiculum gastrale has a broad basal sclerotized portion which is continuous with the first connecting membrane, and a prominent sclerotized rod which projects anteriorly in the body. This type of structure was illustrated by Burke (1959) for *Anthonomus,* Schoof (1942) for *Conotrachelus,* Hieke (1966) for *Liparus,* and Jeannel and Paulian (1944) for *Ectomnorrhipus* and *Phyllobius,* and is also present in the brentid, *Arrhenodes* (Fig. 1). I observed a similar type of spiculum gastrale in the curculionid subfamilies Brachyrrhininae, Thylacitinae, Tanymecinae, Leptopiinae, Cylindrorhininae, Hylobiinae, Erirhininae, Apioninae, Rhynchitinae, Pterocolinae, Myrmecinae, Anthonominae, Rhynchaeninae, Cryptorohynchinae, Ceutorynchinae, and Baridinae. The basal portion may be very lightly sclerotized and often the edges are difficult to distinguish from the membrane with which they are continuous. In *Pissodes* (Pissodinae) (Hopkins 1911) and *Lixus* (Cleoninae) (Morimoto 1962) the basal portion is apparently completely membranous, and only the rod is discernible.

In *Curculio* the rod of the spiculum gastrale appears to arise directly from the first connecting membrane (Fig. 2). Lying in the membrane on each side of the base of the rod are 2 sclerotized pieces which Bissell (1937) called "spicule plates". Gilbert (1952) described what he called spicule plates in



Figs. 1-4, ventral views of spiculi gastrale of: 1) *Arrhenodes minuta* (Drury) (Brentidae); 2) *Curculio victoriensis* Pierce (Curculioninae); 3) *Tychius tectus* LeConte (Tychiinae); 4) *Sibinia suturalis* (Schaeffer) (Tychiinae).

the trogositid *Temnochila* and in the curculionids *Eugnamptus* (Eugnamptinae) and *Cossonus* (Cossoninae); these sclerites are connected to the spiculum gastrale in *Cossonus*. In the specimens of *Eugnamptus* that I examined there is a large sclerotized area continuous with the first connecting membrane which lies between the basal portion of the spiculum gastrale and sternum VIII but which is not attached to either. I observed a similar but much smaller sclerite in *Arrhenodes*. No muscles attach to these sclerites and it is doubtful that they are homologous to Bissel's (1937) "spicule plates" of *Curculio*. Conversely, muscles attached to these "spicule plates" are homologous to the muscles attached to the basal portion of the spiculum gastrale in the other forms studied. The "spicule plates" in *Curculio* then should be considered homologous to the basal portion of the spiculum gastrale and not to the "spicule plates" described by Gilbert in *Temnochila, Eugnamptus,* and *Cossonus.*

In Rhynchophorinae, the first connecting membrane forms an expanded rigid opaque tube which Sharp (1918) called the pseudo-tegmen (pt, figs. 10-13). In *Scyphophorus* the rod of the spiculum gastrale arises in the medioventral portion of the pseudo-tegmen (Fig. 11). Muscles whose homologs attach to the basal portion of the spiculum gastrale in most other Curculionoidea are attached to the lateral and ventral surfaces of the pseudotegmen in *Scyphophorus.* The spiculum gastrale is absent in some Rhynchophorinae (Sharp 1918).

In *Tychius,* the rod of the spiculum gastrale diverges at its base to form a Y-shaped structure (Fig. 3). The arms of the Y are simply thickened portions of a large basal sclerotized plate. The rod is comparatively short and the apex bears knobs which increase area for muscle attachment.

In *Sibinia* the rod of the spiculum gastrale is absent (Fig. 4). The basal portion is modified to consist of 3 separate sclerotized plates, 2 large anterolateral plates and a small posteromedian plate. The muscles attached to these plates are homologous to those arising on the basal portion of the spiculum gastrale in those Curculionoidea which do have a spiculum rod. The anterolateral plates are firmly attached posteriorly to the basal piece of the tegmen by a short stiff membrane so that the 2 structures function as an inflexible unit instead of independently.

MUSCULATURE OF THE GENITAL COMPLEX

Ten muscle bands are directly or indirectly involved with protraction and retraction of the median lobe. These bands have their origins and insertions on the tegmen, spiculum gastrale, median struts, tergum VIII, and sternum VII or VIII. Since some homologous bands have different functions and/or points of origin or insertion, they are here designated by numbers. Table 1 lists probable homology of muscles described here and those described by other workers.

Genital Muscle Number 1 (GM-1)

GM-1 is the protractor of the median lobe. It may consist of a pair of bands or a single band and is present in all of the forms studied. The origin is on the basal piece of the tegmen, the insertion on the apical portions of the median struts. Upon contraction of GM-1 the median lobe is moved posteriorly.

In *Arrhenodes, Curculio, Tychius, Scyphophorus, Crossotarsus,* and *Anthonomus* 2 separate and distinct bands can be discerned. In *Curculio* (Fig. 8), *Scyphophorus* (Fig. 10), and *Anthonomus* these originate on the ventral and lateral margins of the basal piece of the tegmen. In *Arrhenodes* (Figs. 5 and 7), *Tychius* (Fig. 14) and *Crossotarsus,* the origin is on the points of the arms of the Y-shaped tegmen.

In *Sibinia* and *Liparus,* GM-1 is a single, broad band. In *Sibinia* (Fig. 15) its origin is dorsal to the median lobe on the dorsal membranous portion of the ring formed by the basal piece of the tegmen.

In *Arrhenodes* (Figs. 5 and 7) the insertion is on the ventral surface of the flattened apices of the median struts. In all other forms examined (Figs. 8, 10, and 15) the insertion is along the sides of the apices of the median struts.

Genital Muscle Number 2 (GM-2)

In most curculionoids studied GM-2 is a protractor of the median lobe. It consists of a pair of bands in all forms studied. The origin is on the apex of the tegminal strut and the insertion on the inner, or in *Arrhenodes,* on the ventral surfaces of the median struts (Figs. 6, 7, 8, 12, and 14). In *Dendroctonus* the tegminal strut is absent and in *Liparus* it is very short. In these GM-1 and GM-2 are indistinguishable. No trace of GM-2 could be found in *Sibinia.*

In *Scyphophorus* (Fig. 12) the tegminal strut is very long and in that genus GM-2 must act as a retractor of the median lobe.

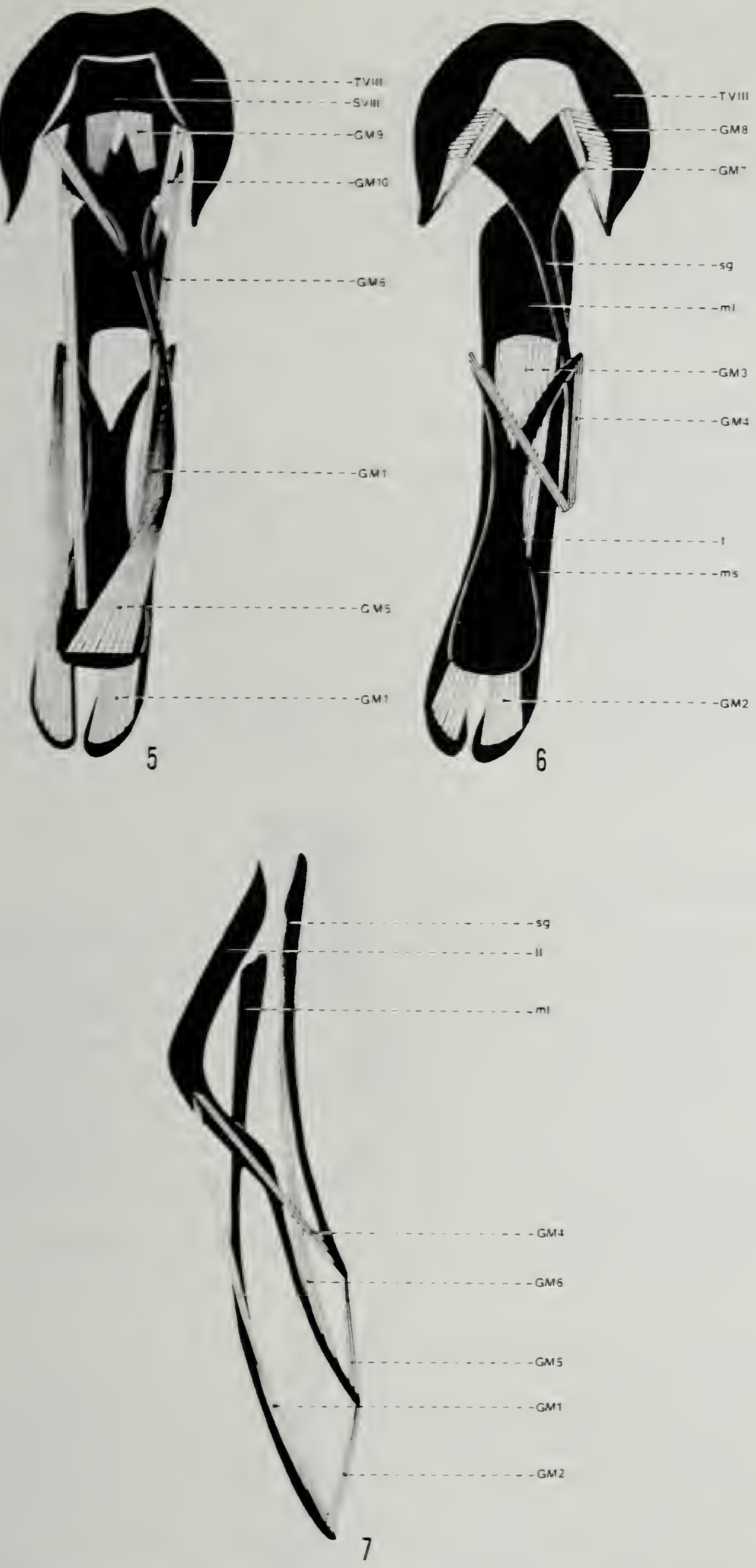
Genital Muscle Number 3 (GM-3)

GM-3 is a retractor of the median lobe. Its origin is on the apical portion of the tegminal strut except in *Dendroctonus* where it is on the apex of the rod of the spiculum gastrale. In *Arrhenodes* (Figs. 6 and 7), *Anthonomus,* and *Sibinia* (Fig. 15) GM-3 consists of a single band inserting along the apicoventral margin of the median lobe. In *Curculio* (Fig. 9), and *Tychius* it is composed of a pair of bands inserting laterally on the apicoventral margin of the median lobe, in *Scyphophorus* (Fig. 13) on the bases of the median struts themselves.

Genital Muscle Number 4 (GM-4)

In *Arrhenodes* (Figs. 6 and 7), *Curculio* (Fig. 9), *Scyphophorus* (Fig. 12), *Liparus,* and *Anthonomus,* GM-4 functions as a retractor of the tegmen. In *Tychius* (Fig. 14) it binds the tegmen and spiculum gastrale together so that they move together as a single unit. GM-4 is absent in *Sibinia* where the spiculum gastrale and tegmen are fused into a single unit retracted by GM-7 and GM-8. Hopkins did not illustrate comparable bands in *Dendroctonus* or *Crossotarsus.*

The origin of GM-4 is on the extreme apex of the rod of the spiculum gastrale, the insertion on the basal piece of the tegmen. In *Scyphophorus* the insertion is on the lateral surfaces and in *Curculio, Liparus,* and *Anthonomus* on the left ventral and lateral surfaces of the basal piece of the tegmen. In *Arrhenodes* and *Tychius* the insertion is on the points of the arms of the Y-shaped tegmen.



Figs. 5-7, male genital complex of *Arrhenodes minuta* (Drury): 5) ventral view showing protractor muscles; 6) ventral view showing retractor muscles; 7) lateral view showing protractor and retractor muscles.

Genital Muscle Number 5 (GM-5)

According to Burke (1959) this band is a retractor of the tegmen in *Anthonomus.* In *Arrhenodes* (Figs. 5 and 7) GM-5 cannot function as a retractor because of the position of the tegmen in relation to the spiculum gastrale when the later is contracted, and must serve mainly to stabilize the apex of the rod of the spiculum gastrale. GM-5 may be homologous to part of GM-4 in *Tychius* and *Liparus.* It was not observed in *Scyphophorus, Sibinia,* and *Curculio* and was not illustrated by Hopkins in *Dendroctonus* or *Crossotarsus.*

Genital Muscle Number 6 (GM-6)

GM-6 is a protractor of the tegmen. When present it consists of a pair of bands. In *Arrhenodes* (Figs. 5 and 7), *Curculio* (Fig. 8), *Anthonomus,* and *Liparus,* the origin is on the anterior margin of the basal portion of the spiculum gastrale, the insertion on the ventral and lateral margins of the pseudo-tegmen. In *Dendroctonus* and *Crossotarsus,* according to Hopkins (1915) the origin is on the posterior margin of sternum VIII rather than on the spiculum gastrale.

GM-6 is absent in *Tychius* and *Sibinia.* Protraction of the tegmen is accomplished by the protractors of the spiculum gastrale which are connected to the tegmen.

Genital Muscle Number 7 (GM-7)

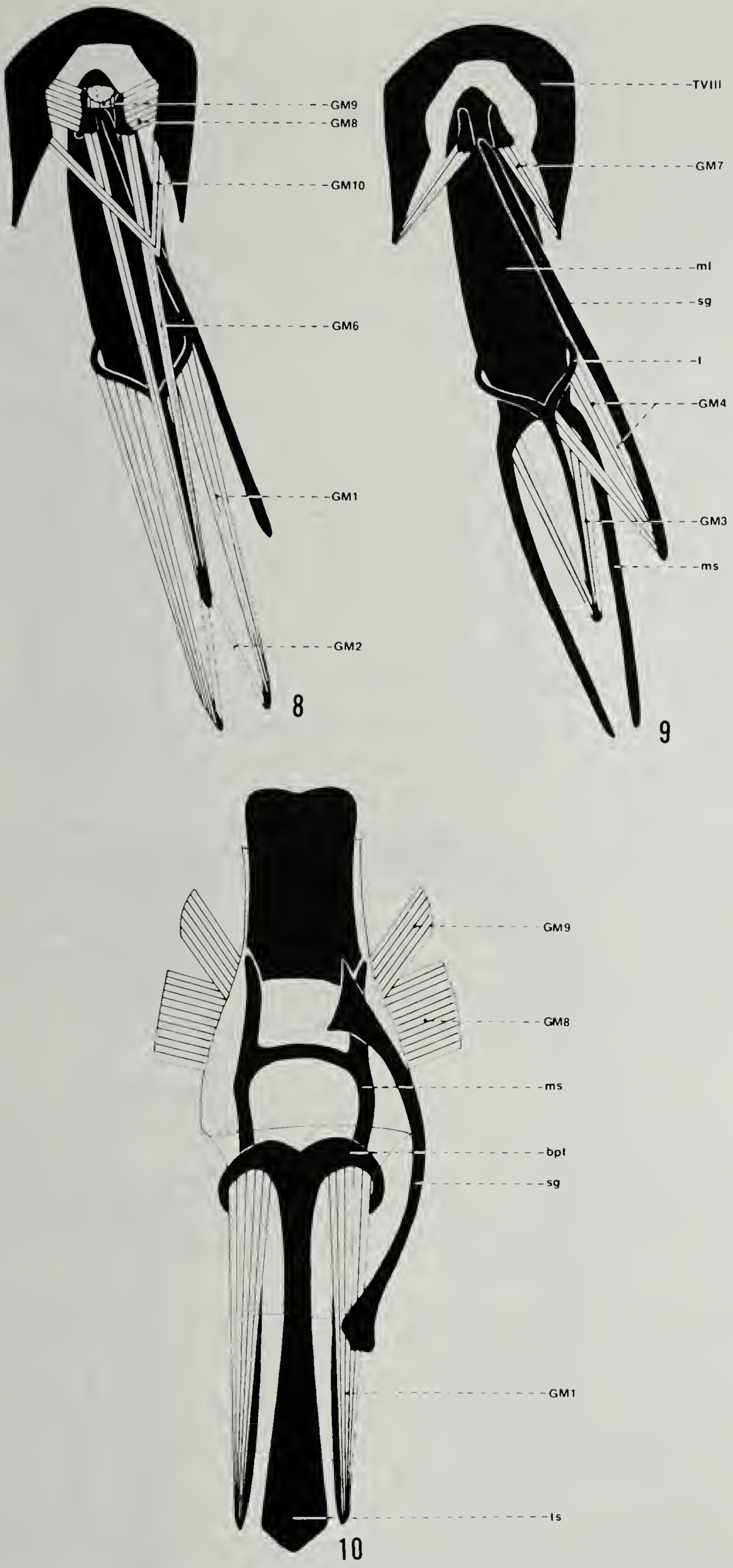
GM-7 is antagonistic to GM-9 and GM-10. It moves the basal portion of the spiculum gastrale forward in the body. It consists of a pair of bands with origins on the basal apodemes of tergum VIII. The insertion in *Curculio* (Fig. 9), *Anthonomus,* and *Tychius* (Fig. 14) is on the base of the spiculum gastrale in *Arrhenodes* (Fig. 6) on the posterior angles of that structure, in *Scyphophorus* (Fig. 12) on the posterolateral surface of the pseudo-tegmen near the point of attachment of the median lobe and the median struts, and in *Sibinia* (Fig. 15) on the posterior extremes of the anterolateral plates of the spiculum gastrale.

GM-7 is apparently absent in *Dendroctonus* and *Crossotarsus.*

Genital Muscle Number 8 (GM-8)

GM-8 is a suspensor of the basal portion of the spiculum gastrale. It consists of a pair of bands which originate on tergum VIII. Upon contraction of GM-8 the basal portion of the spiculum gastrale is pulled upward and slightly anteriorly toward tergum VIII. The insertion is on the basal portion of the spiculum gastrale on the lateral margin in *Curculio* (Fig. 8), *Tychius* (Fig. 15), and *Anthonomus,* on the posterior angles in *Arrhenodes* (Fig. 6), and on the lateral margins of the anterolateral plates in *Sibinia* (Fig. 15). In *Scyphophorus* (Fig. 10) the insertion is on the lateral surfaces of the pseudo-tegmen slightly anterior to the point of attachment of the spiculum gastrale.

GM-8 is apparently absent in *Dendroctonus* and *Crossotarsus.*



Figs. 8-10, ventral views of male genital complex of: 8) *Curculio victoriensis* Pierce showing protractor muscles; 9) the same showing retractor muscles; 10) *Scyphophorus acupunctatus* Gyll. showing some protractor muscles.

Genital Muscle Number 9 (GM-9)

GM-9 consists of a pair of bands which are antagonistic to GM-7 and GM-8. Its contraction pulls the basal portion of the spiculum gastrale posteriorly and ventrally in the body. It is absent in *Anthonomus* and apparently in *Crossotarsus.*

The origin in *Arrhenodes* (Fig. 5), *Liparus, Curculio* (Fig. 8), *Dendroctonus,* and *Pissodes* is on the anterior margin of sternum VIII, in *Scyphophorus* (Fig. 10) on the dorsomedian surface of that structure. In *Tychius* (Fig. 14) and *Sibinia* (Fig. 15) sternum VIII is reduced to 2 small lateral disc shaped sclerites, and the origin of GM-9 is on the dorsal surface of sternum VII.

The insertion in *Curculio, Liparus,* and *Tychius* is on the dorsomedian surface of the basal portion of the spiculum gastrale, in *Scyphophorus* on the posterolateral surface of the pseudo-tegmen near the point of attachment of the median lobe and median struts. In *Sibinia* 4 distinct bands can be distinguished, 2 of which insert on the posteromedian plate, the other 2 on the inner edge of the posterior portion of the anterolateral plates of the spiculum gastrale.

Genital Muscle Number 10 (GM-10)

GM-10 consists of a pair of bands antagonistic to GM-7. Upon contraction of these bands the spiculum gastrale is moved posteriorly in the body. The origin is on the anterior margin of sternum VIII in *Arrhenodes* (Fig. 5) and on the ventrolateral margin of tergum VIII just anterior to the point of articulation with sternum VIII in *Curculio* (Fig. 8), *Tychius* (Fig. 14), and *Sibinia* (Fig. 15). The insertion is on the rod of the spiculum gastrale in about the basal 1/3 to 1/2 in *Arrhenodes* and on the extreme apex in *Tychius.* In *Sibinia* (Fig. 15) the insertion is on the inner median surface of the anterolateral plates of the spiculum gastrale.

GM-10 is absent in *Anthonomus* and *Scyphophorus.*

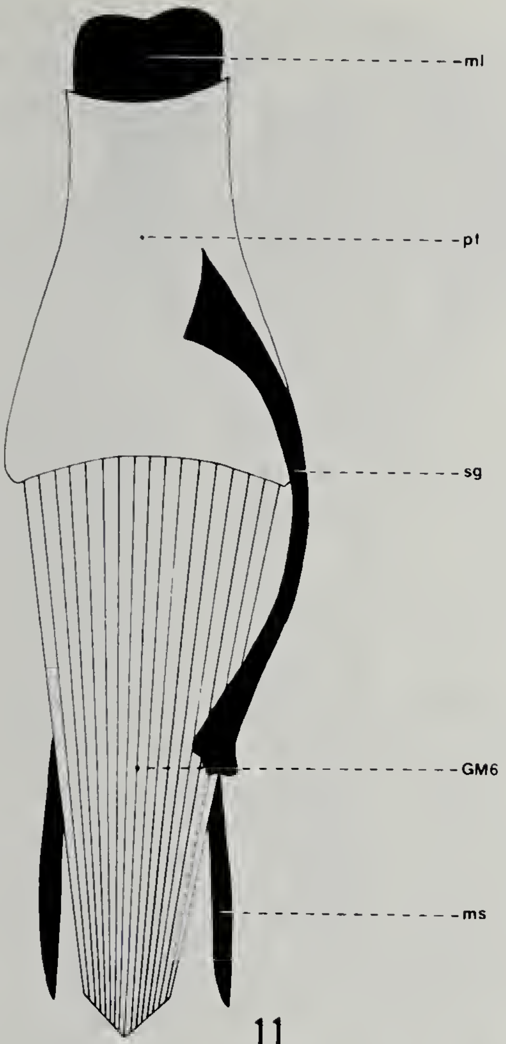
Protrusion and Retraction of the Median Lobe

This is accomplished by contraction of muscles attached to tergum VIII, sternum VIII or VII, the spiculum gastrale, and the tegmen. The process may be viewed as occurring in 2 steps, each composed of 3 substeps as follows:

Step 1—protrusion of the median lobe—substep 1: protraction of the spiculum gastrale; substep 2: protraction of the tegmen; substep 3: protrusion of the median lobe.

Step 2—retraction of the median lobe—substep 1: retraction of the spiculum gastrale; substep 2: retraction of the tegmen; substep 3: retraction of the median lobe.

In general features, the structure of the genital complex of *Arrhenodes* (Figs. 5-7), *Anthonomus,* and of *Curculio* (Figs. 8 and 9) are the same. In these genera, protrusion and retraction of the median lobe are accomplished as follows. Contraction of GM-8 and GM-10 pulls the basal portion of the spiculum gastrale posteriorly and probably slightly dorsally. With the spiculum gastrale in this position contraction of GM-6 pulls the tegmen posteriorly, bringing GM-1 and GM-2 into position to pull the median lobe posteriorly.



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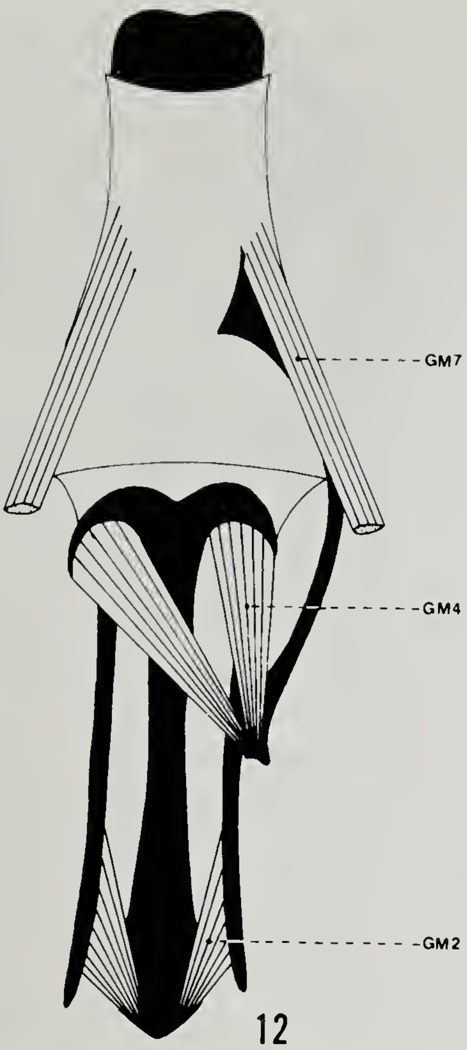

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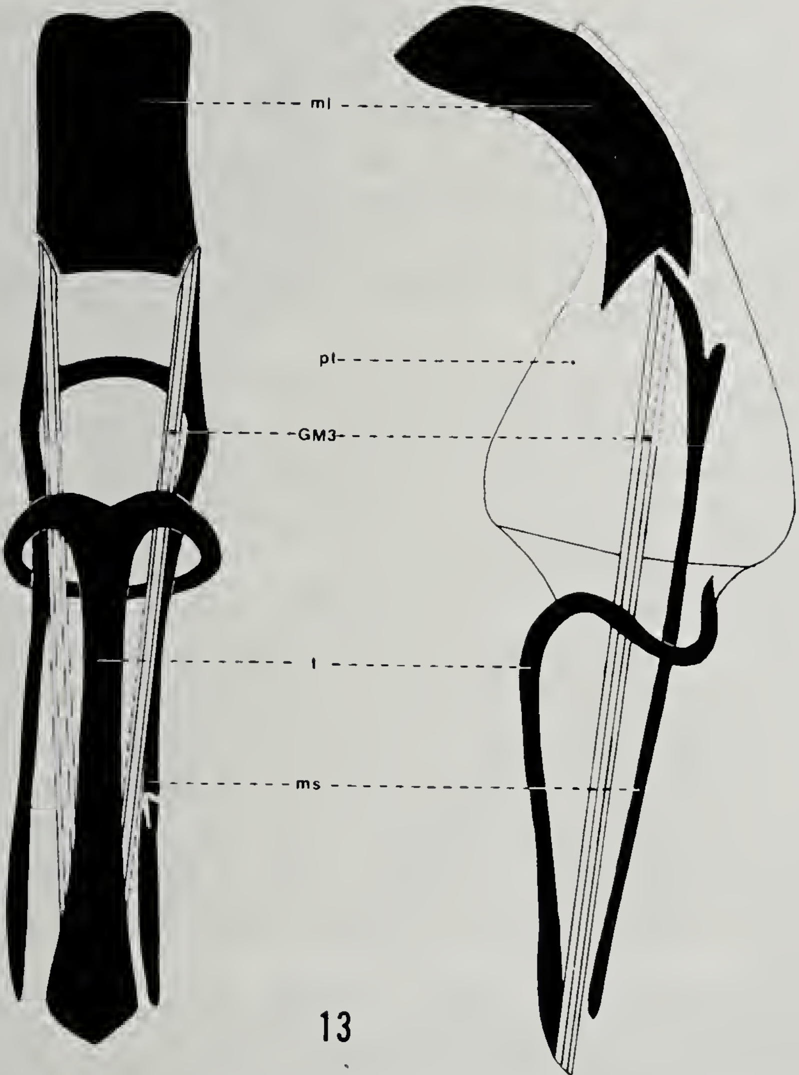

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Figs. 11-13, male genital complex of *Scyphophorus acupunctatus* Gyll.: 11) ventral view showing some protractor muscles; 12) ventral view showing some retractor muscles; 13) ventral and lateral views showing some retractor muscles.

The reverse procedure brings the parts back to their resting position; first GM-7 contracts to bring the basal portion of the spiculum gastrale back to its resting position. Acting with GM-7, GM-9 also pulls the spiculum gastrale anteriorly and probably also ventrally.

With the spiculum gastrale restored, the tegmen can be retracted. This is accomplished by contraction of GM-4 which pulls the tegmen anteriorly. Spiculum gastrale and tegmen both restored, contraction of GM-3 pulls the median lobe back into the body.

The same 6 substep sequence occurs in protrusion and retraction of the median lobe in *Scyphophorus* (Figs. 10-13) but here there are structural modifications which give some homologous muscles a different function. The most obvious structural modification in *Scyphophorus* is the thickening and consequent rigidity of the first connecting membrane to form the pseudo-tegmen. Muscles whose homologs attach to the basal portion of the spiculum gastrale in *Arrhenodes* and *Curculio,* are in *Scyphophorus* attached to the pseudo-tegmen, although here they occupy approximately the same position relative to the median lobe and tergum VIII. In *Scyphophorus* GM-10 is absent and GM-9 pulls the pseudo-tegmen and consequently the spiculum gastrale posteriorly instead of anteriorly. The tegminal strut is much longer in relation to the median struts in *Scyphophorus* than in *Arrhenodes* and *Curculio.* In *Scyphophorus* GM-2 is a retractor of the tegmen instead of a protractor of the median lobe.

In *Scyphophorus* protrusion and retraction of the median lobe proceeds as follows. Contraction of GM-9 pulls the pseudo-tegmen posteriorly and probably slightly ventrally. The pseudo-tegmen in contracted position GM-6 pulls the tegmen posteriorly, beneath the anterior margin of the pseudo-tegmen, then contraction of GM-1 protrudes the median lobe.

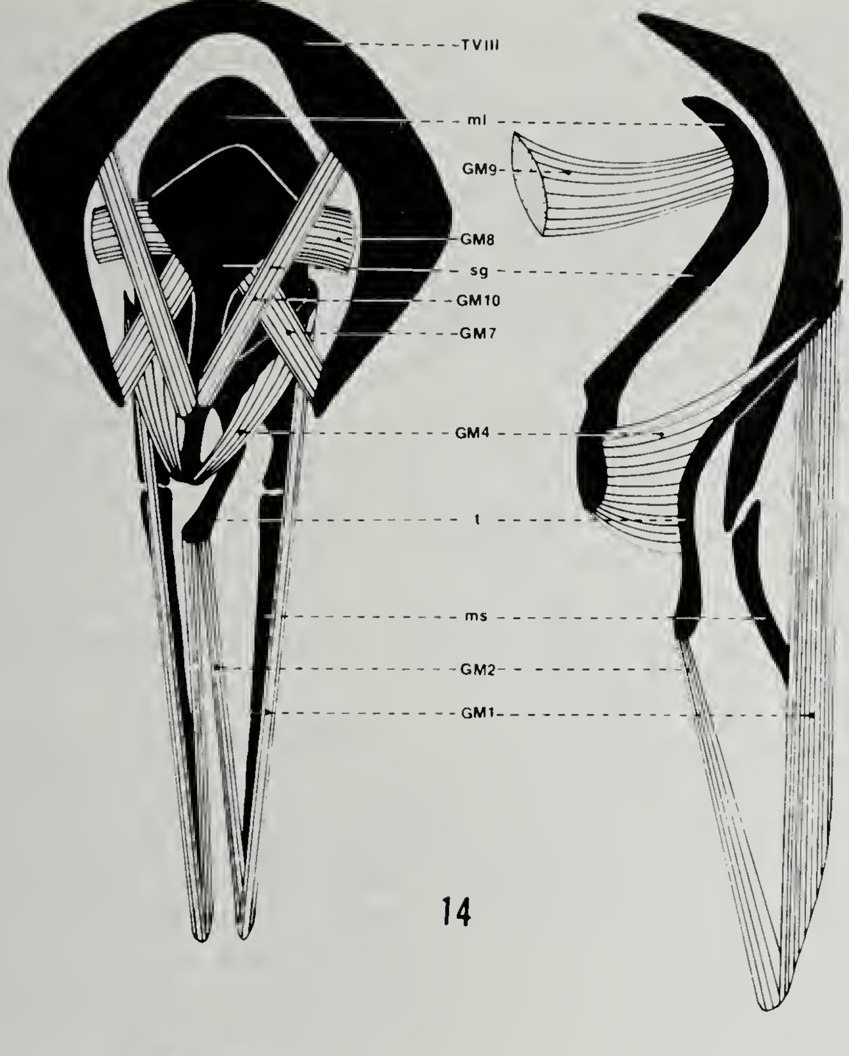
The first phase of retraction of the median lobe is the contraction of GM-7 and GM-8 which brings the pseudo-tegmen and spiculum gastrale anteriorly to their resting position. Then contraction of GM-4 and GM-2 brings the tegmen forward, and contraction of GM-3 brings the median lobe back into the body.

In *Tychius* (Fig. 14) and *Sibinia* (Fig. 15), the 6 substeps are reduced to 4 because the spiculum gastrale and tegmen are coupled into 1 functional unit. This eliminates the separate substeps necessary for protraction and retraction of the tegmen. Another modification is the shift of the origin of GM-9 from sternum VIII to sternum VII.

Protrusion and retraction of the median lobe in *Tychius* and *Sibinia* is as follows. Contraction of GM-9 and GM-10 pulls the spiculum gastrale posteriorly and ventrally in the body. In *Tychius* GM-4 holds the spiculum gastrale and the tegmen together so that they function as a single unit; in *Sibinia* GM-4 is absent and fusion is accomplished by a membranous connection between the spiculum gastrale and the basal piece of the tegmen. Next in *Tychius,* contraction of GM-1 and GM-2 pulls the median lobe posteriorly and out of the body; in *Sibinia* GM-2 is absent and protrusion is by GM-1 alone.

Retraction of the median lobe is accomplished in 2 steps: contraction of GM-7 and GM-8 pulls the spiculum base and tegmen forward in the body; GM-3 contracts and pulls the median lobe back into the body.

The following discussion of function in *Dendroctonus* and *Crossotarsus* is based solely on Hopkins figures. No direct observations were made.



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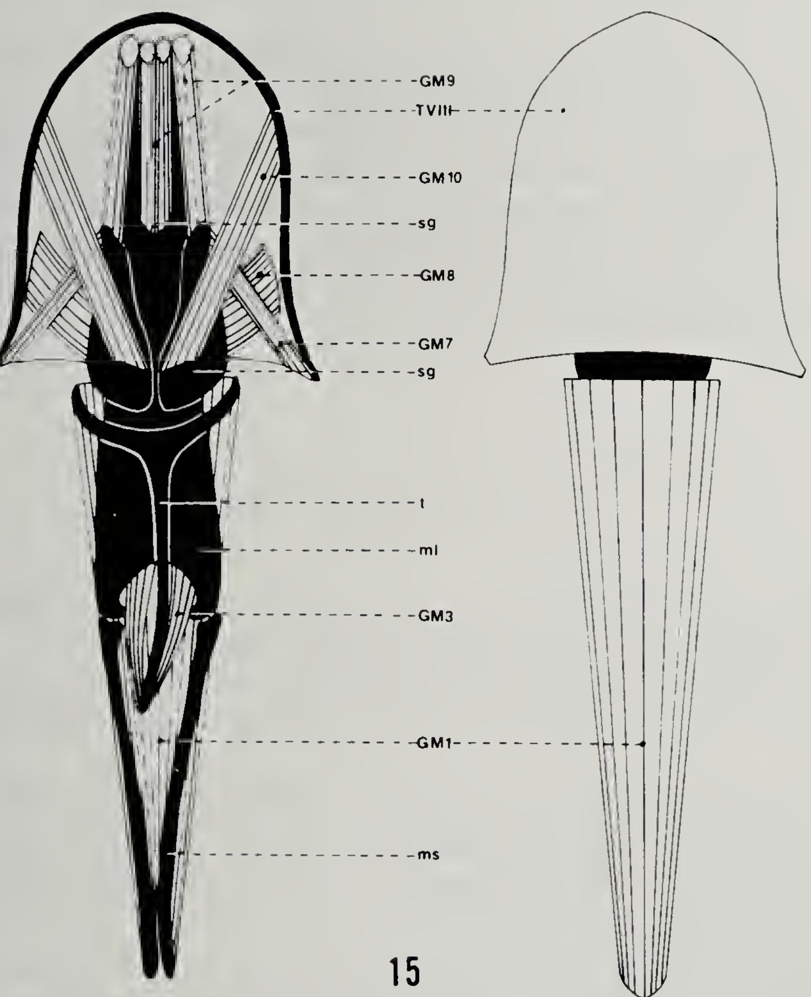

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Figs. 14-15, ventral and lateral views of male genital complex of: 14) *Tychius tectus* LeConte showing protractor and retractor muscles; 15) *Sibinia suturalis* (Schaeffer) showing protractor and retractor muscles.

In *Dendroctonus* there are apparently no protractors or retractors of the spiculum gastrale so it must remain stationary during protraction and retraction of the median lobe. Hopkins does not illustrate a retractor of the tegmen either. The following description is therefore tentative.

Step 1, protrusion of the median lobe proceeds as follows: contraction of GM-6 (e3 in Hopkins figure) pulls the tegmen posteriorly; GM-1 (e1) contracts and the median lobe is protruded.

The sequence in step 2 is unclear since no retractor of the tegmen is figured. Evidently the need for substep 1, retraction of the spiculum gastrale, is eliminated because that structure remains stationary. It is possible that part of the large complex band labelled e1, and called the protractor, is actually connected to the apical portion of the spiculum gastrale and acts as a retractor of the tegmen. GM-3 (e2) is attached to the apex of the spiculum gastrale instead of to the apex of the tegminal strut, but its contraction accomplishes the same thing as in the other forms studied, namely retraction of the median lobe.

There is no spiculum gastrale in *Crossotarsus*. The first step, protrusion of the median lobe, proceeds as follows: GM-6 (e3), which originates on sternum VIII and inserts on the tegmen, contracts and pulls the tegmen posteriorly. Protrusion of the median lobe is accomplished by contraction of GM-1 (e1). Again, as in *Dendroctonus*, no retractors of the tegmen are illustrated so it is unclear how this structure is restored to its resting position. GM-3 (e2) is certainly the retractor of the median lobe.

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I wish to thank J. C. Schaffner of Texas A&M University, under whose direction this study was carried out, and H. R. Burke of the same institution for suggestions and encouragement in its completion. For constructive criticism of various drafts of the manuscript I thank F. Hieke, J. M. Kingsolver, and S. L. Wood. I am especially grateful to my wife, Glenora Jean Clark, for typing and other assistance.

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LITERATURE NOTICE

The larval characters of featherwing and limulodid beetles and their family relationships in the Staphylinoidea (Coleoptera: Ptiliidae and Limulodidae), by Henry S. Dybas. 1976. Fieldiana: Zoology 70 (3):29-78.

—D. R. Whitehead

WATER BEETLE RECORDS FROM CENTRAL NEW YORK

George Swenson

Ithaca College, Ithaca, NY 14850

Dytiscidae: *Celina angustata* Aube. Five specimens were collected at a light trap near Ithaca, Thompkins County, in 1972, 1974, and 1975; another was netted from a permanent pond about one mile east of the village of Lodi, Seneca County. This species seems to be primarily southern, though specimens have been reported from Ohio, Indiana, and Michigan (Young 1954). Previous New York records are from New York City and Staten Island (Leonard 1928) and Long Island (Blackwelder 1973).

Noteridae: *Suphisellus puncticollis* Crotch. Four specimens were netted from the pond near Lodi mentioned above, on 3 different dates during 1976. Previous New York records are New York City, Staten Island, and Waccabuc Lake, all in the coastal region (Leonard 1928); the Cornell University collection includes 2 specimens collected by Roy Latham in 1943 from Orient, Long Island.

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* * *

LITERATURE NOTICES

A taxonomic revision of the New World subaquatic genus *Neochetina* (Coleoptera: Curculionidae: Bagoini), by Charles W. O'Brien. 1976. Annals Ent. Society America 69(2):165-174.

Host plants and parasites of some Arizona seed-feeding insects, by Ted D. Center & Clarence Dan Johnson. 1976. Annals Ent. Society America 69(2):195-201.

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—Paul P. Shubeck

THREE NEW SPECIES OF *SENNIUS* FROM MEXICO AND CENTRAL AMERICA, WITH NEW HOST RECORDS FOR OTHER *SENNIUS* (COLEOPTERA: BRUCHIDAE)

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Abstract

The new species *Sennius colima* from Mexico and *S. lawrencei* and *S. panama* from Panama are described. The dorsal aspects, hind legs and male genitalia of each are figured. *S. colima* develops in the seeds of *Cassia berlandieri*; *S. lawrencei* in the seeds of *C. reticulata*; and *S. panama* in the seeds of *C. undulata*. *Bruchus rufescens* Motschulsky was found to be a *Sennius* and the senior synonym of *Sennius celatus* (Sharp). Five species of *Sennius* had no previous host plants recorded for them. These bruchids and their hosts are *S. breveapicalis (Cassia densiflora, C. undulata); S. ensiculus (Cassia patellaria); S. militaris (Cassia emarginata); S. obesulus (Cassia wrightii); S. trinotaticollis (Cassia maxonii, C. oxyphylla).* New host records for other species of *Sennius* are as follows: *S. auricomus (Cassia xiphoidea); S. rufescens (Cassia leptocarpa, C. reticulata, C. tora); S. fallax (Cassia berlandieri, C. hintoni); S. guttifer (Cassia nicaraguensis); S. instabilis (Cassia biflora, C. leptocarpa, C. tora).*

Introduction

After Bridwell (1946) named the genus *Sennius*, little systematic work was done on the species in the genus until Johnson and Kingsolver (1973) revised the North and Central American species of the genus. Since 1973, Center and Johnson (1973, 1974, 1976), Whitehead and Kingsolver (1975a, 1975b), and Pfaffenberger and Johnson (1976) have published papers that, at least in part, are concerned with host plants, evolution, new species, and larvae of *Sennius*. Because there is considerable current interest in the ecology of the Bruchidae and names are needed for these studies, 3 new species of *Sennius* are described in this paper.

With the exception of *Sennius willei*, reported to develop "in alfalfa seed" (Kingsolver 1968), all verified hosts for species of *Sennius* are in the genus *Cassia* (Leguminosae). Because *Sennius* is mostly limited to hosts in the genus *Cassia*, the genus is of great interest for comparative studies on the ecology of the Bruchidae. The genus *Cassia* contains about 600 species which are mostly tropical and subtropical in distribution (Heywood 1971). The predominant bruchids that prey on seeds of Old World *Cassia* are in the genus *Caryedon*, whereas species of *Sennius* are the most common bruchids in the seeds of New World *Cassia*. Apparently, then, adaptive radiations of these 2 bruchid genera have occurred into a similar niche, the seeds of species of *Cassia*. The complex interrelationships between these bruchids and their seed hosts will be the subject of future research.

Host plants were not known for 8 of the 27 species of *Sennius* treated by Johnson and Kingsolver (1973). Hosts for 5 (*S. breveapicalis, S. ensiculus, S. militaris, S. obesulus, S. trinotaticollis*) of these 8 species are known and are reported below along with additional host records for species with previously recorded hosts.

For ease of access to host records, Tables 1 and 2 are cross-referenced between host plants and the species of *Sennius* included in this paper.

Methods used by Johnson (1970) for collecting and rearing were followed. In the text of this paper C. D. Johnson is abbreviated CDJ, and L. J. Bottimer is abbreviated LJB.

Acknowledgments

I am most grateful to Cheryl and Margaret Johnson for help with the field work for this research, and to R. Medina and J. Floyd for laboratory assistance. J. Floyd drew the habitus and hind leg figures.

Thanks are also due D. E. Bright and E. C. Becker, Canadian National Collection of Insects, Ottawa, for lending specimens collected by Bottimer to me. I thank R. Liesner and T. Croat, Missouri Botanical Garden, for plant identifications, and J. Kingsolver for critical reading of the manuscript.

Partial financial assistance was provided by the Insect Identification and Beneficial Insect Introduction Institute, ARS, U.S. Department of Agriculture, under Grant 12-14-100-9970 (33).

A New Synonymy and New Combination in *Sennius*

Motschulsky (1874, p. 222) described *Bruchus rufescens* from Colombia. J. M. Kingsolver recently examined the type of this species and found that it was conspecific with *Sennius celatus* (Sharp 1885, p. 499), described from Panama. Therefore, *Sennius rufescens* (Motschulsky), **new combination**, becomes the senior synonym of *S. celatus* (Sharp), **new synonymy**. A junior primary homonym, *Bruchus rufescens* (Schaeffer 1907) is now known as *Acanthoscelides schaefferi* (Pic 1912).

New Species of *Sennius*

Sennius colima Johnson, **new species**

(Figs. 1-2; 5-6)

Length (Pronotum-elytra) 2.5-3.3 mm. Width 1.85-2.5 mm. Maximum thoracic depth 1.5-2.0 mm.

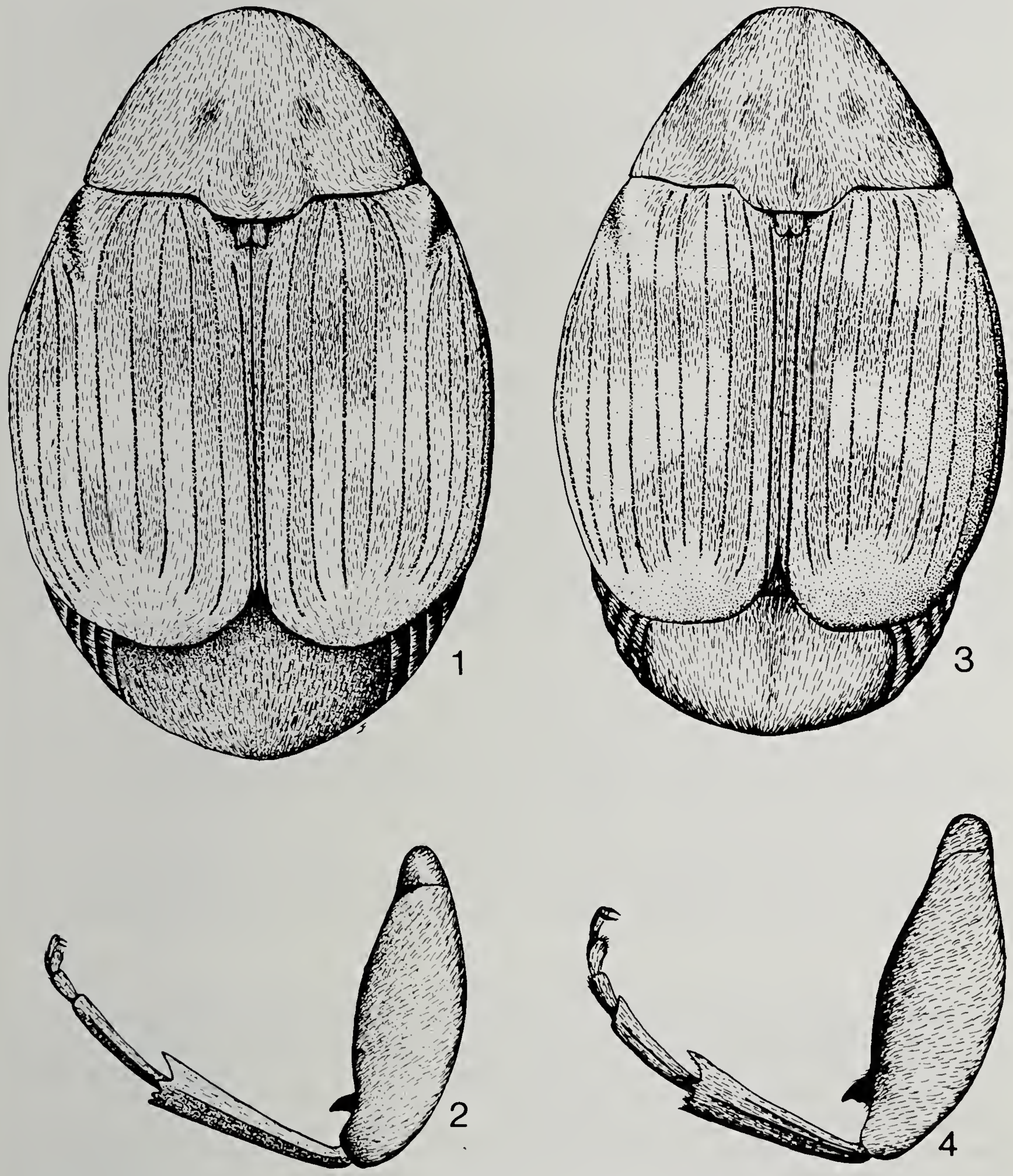
Male

Integument color

Head dark brown; antennae with basal 5 segments and 11th red orange, sometimes 5th dark brown on upper surface, remaining segments dark brown. Prothorax dark brown, meso- and metathoracic sterna varying from red orange to dark brown. About basal 1/2 of elytron red orange, about apical 1/2 of elytron light brown due to slightly darker pigmentation and cover of dark brown hairs (fig. 1); sometimes dark-brown line extending for about 1/4 length of elytron on interval between striae 3 and 4; pygidium, remainder of undersurfaces, and legs red orange.

Vestiture

With recumbent white, yellow, brown, and dark brown hairs as follows: eye with medial fringe of white hairs; postocular lobe with short white hairs; dense postocular patch of white hairs; remainder of head with intermixed moderately dense brown and white hairs; pronotum with vague pattern, usually slender line of yellow to white hairs along midline flanked by 2 lines of hairs on about basal 1/2 of pronotum, usually 2 spots of white hairs near lateral margins about 1/2 way from base to apex (fig. 1), remainder of pronotum with intermixed brown and white hairs; vestiture of elytron variable but usually about basal 1/2 with moderately dense white to yellow hairs, apical 1/2 usually covered with dark brown hairs, often vague white patches of hairs amongst dark brown hairs on intervals between striae 2 and 3, 4 and 5, and 6 and 7; pygidium, undersurfaces, and legs covered with moderately dense to dense white to yellow hairs.



Figs. 1-2, *Sennius colima*: 1, habitus; 2, hind leg; Figs. 3-4, *S. panama*: 3, habitus; 4, hind leg.

Structure

Head.—Slightly elongate, densely punctulate; frons with median, glabrous, finely punctulate line extending from frontoclypeal suture to vertex; vague transverse sulcus between upper limits of eyes; width of eye slightly wider than width of frons; ocular sinus about 1/3 as long as width of eye; posterior margin of eye protruding from adjacent surfaces; postocular lobe strong, rounded, not angulate; distance from base of antennae to apex of labrum about 1/2 as long as distance from upper limits of eyes to apex of labrum; antennal segments 1 and 3 usually filiform, 2 and 4 usually moniliform; 5 to 10 eccentric, 11th subacute apically; 5 to 11 slightly broader than long; antenna reaching to or almost to humerus.

Prothorax.—Disk campanulate (fig. 1), with many punctations, punctations more coarse at base and lateral margins; cervical sulcus shallow, extending from near coxal cavity to about 1/3 distance to pronotal midline; lateral prothoracic carina vague, extending about 1/3 distance from base to coxal cavity; short median impressed line on median basal lobe usually obscured by pubescence; prosternum separating procoxae for about 0.8 their length.

Mesothorax and Metathorax.—Scutellum small, slightly transverse, with lateral posterior teeth, clothed with dense recumbent white hairs; elytron slightly less than twice as long as broad; striae shallow, punctate, strial intervals punctulate; striae 3 and 4, and 5 and 6 closer to one another at base than to adjacent striae (fig. 1); without spines at base of elytron; humerus rugulose, usually at least partially glabrous; undersurfaces punctate; all of hind coxa punctate; hind femur constricted basally and apically, expanded medially to slightly less than width of coxa (fig. 2); inner ventral surface with a well-marked longitudinal carina, sometimes carina with up to 3 widely spaced, small spines, lateral longitudinal carina vague; femur armed with an inner subapical acuminate spine about as long as width of tibial base; tibia with ventral, lateral, and dorsomesal glabrous longitudinal carinae, without lateroventral carina; dorsal surface without fossa; tibial corona with 3 to 4 spinules, mucro about 0.1 as long as 1st tarsomere; with slight sinus at base of mucro; 1st tarsomere with ventral, lateral and vague mesal glabrous longitudinal carinae.

Abdomen.—Sterna not flattened medially; 1st sternum about 1/2 as long as abdomen, posterior margin straight; sterna 2 to 4 unmodified, 5th emarginate; pygidium punctulate, convex in lateral view.

Genitalia.—Figs. 5, 6. Median lobe moderately long; in ventral view, ventral valve triangular, lateral margins arcuate, base about 3/4 as wide as apex of median lobe, arcuate in lateral view; hinge sclerites large, curved; armature of internal sac consisting of about 2 rows of fine spicules basally which connect to a large T-shaped mass of spines medially, medial mass of spines connected to paired elongate strands of fine spicules on either side of internal sac extending to apex of sac; apex with large, round heavily sclerotized gonopore sclerite. Lateral lobes expanded apically, cleft to about 0.75 their length (fig. 6).

Female

Dark brown line on interval between elytral striae 3 and 4 usually present; apex of last abdominal sternum convex, about as long as 2 preceding sterna.

Host Plants

Cassia berlandieri Bentham vel sp. aff.: Mexico. Colima: 7 mi NE Manzanillo, 7-III-73 (CDJ #401-73). Nayarit: 29 mi SW Compostela, 1-III-73 (CDJ #302-73).

Type Series

Holotype male, allotype female, and 55 paratypes: Mexico. Colima: 7 mi NE Manzanillo, 7-III-73, reared seeds *Cassia berlandieri*, C. D. Johnson collector, #401-73. USNM #72781. One paratype: Mexico. Nayarit: 27 mi SW Compostela, 1-III-73, reared seeds *Cassia berlandieri*, C. D. Johnson collector, #302-73.

Holotype, allotype, and numerous paratypes deposited in the U.S. National Museum of Natural History, Washington, D. C. Paratypes retained in the author's collection and also deposited in the following collection: California Academy of Sciences, San Francisco; Canadian National Collection of Insects, Ottawa; and Museum of Comparative Zoology, Harvard University, Cambridge, Mass.

Discussion

Sennius colima is closely related to *S. breveapicalis* (Pic), *S. lateapicalis* (Pic), and to a new species also described in this paper, *S. panama. S. colima* differs from all 3 of these species in its larger size, an elytral color pattern that is less contrasting (fig. 1), and in the characters of the male genitalia including the large T-shaped mass of spines medially in the internal sac. Both *S. colima* and *S. panama* have paired elongate strands of spines or spicules on either side of the internal sac that neither *S. breveapicalis* nor *S. lateapicalis* has. The hinge sclerites of *S. lateapicalis* are more slender, curved, and elongate than in the other species. There is little variation among individuals of *S. colima* other than size.

Because of its close relationship to *S. breveapicalis, S. colima* is tentatively placed in species group 1 of Johnson and Kingsolver (1973), pending further systematic studies in *Sennius. S. colima* keys to couplet 7 of Johnson and Kingsolver (1973) and is separated from *S. breveapicalis* by the characters given above.

Cassia berlandieri is the only known host for *S. colima*, whereas both *S. breveapicalis* and *S. panama* develop in seeds of *Cassia undulata.*

The specific epithet *colima* is a noun in apposition to *Sennius.*

Sennius lawrencei Johnson, **new species**

(Figs. 7-11)

Length (pronotum-elytra) 2.0-2.6 mm. Width 1.2-1.8 mm. Maximum thoracic depth 1.0-1.5 mm.

Male

Similar to *Sennius colima* but with the following exceptions:

Overall size smaller, less robust, elytral vestiture not contrasting.

Integument Color

Usually head black, sometimes head black with red-orange mouthparts and/or small red-orange postocular spot; basal 4-5 antennal segments red orange, apical 6-7 reddish brown, undersurfaces of antennal segments usually red orange. The remainder of the body has 2 color phases, one with solid red-orange elytra (light phase), the other with black elytra with a medial red-orange maculation (dark phase); there is slight overlap between the 2 phases but they are generally distinct; the *light phase* (fig. 8) varies from being all red orange, except for the black head, to the more usual specimens with dark brown to black pronota, thoracic sterna and hind coxa; sometimes elytra of *light phase* individuals with a very narrow dark brown to black border around entire periphery; *dark phase* individuals usually all black except for red-orange elytral maculation (fig. 7), basal 5 antennal segments, pro- and mesothoracic legs, and about apical 1/2 of hind femur; color of hind leg varies from mostly black to mostly red orange; elytral maculation nearer base than apex, usually occupying area between striae 2-9, and about 4/7 length of elytron; humerus always black so that maculation extends toward base and lateral margin.

Vestiture

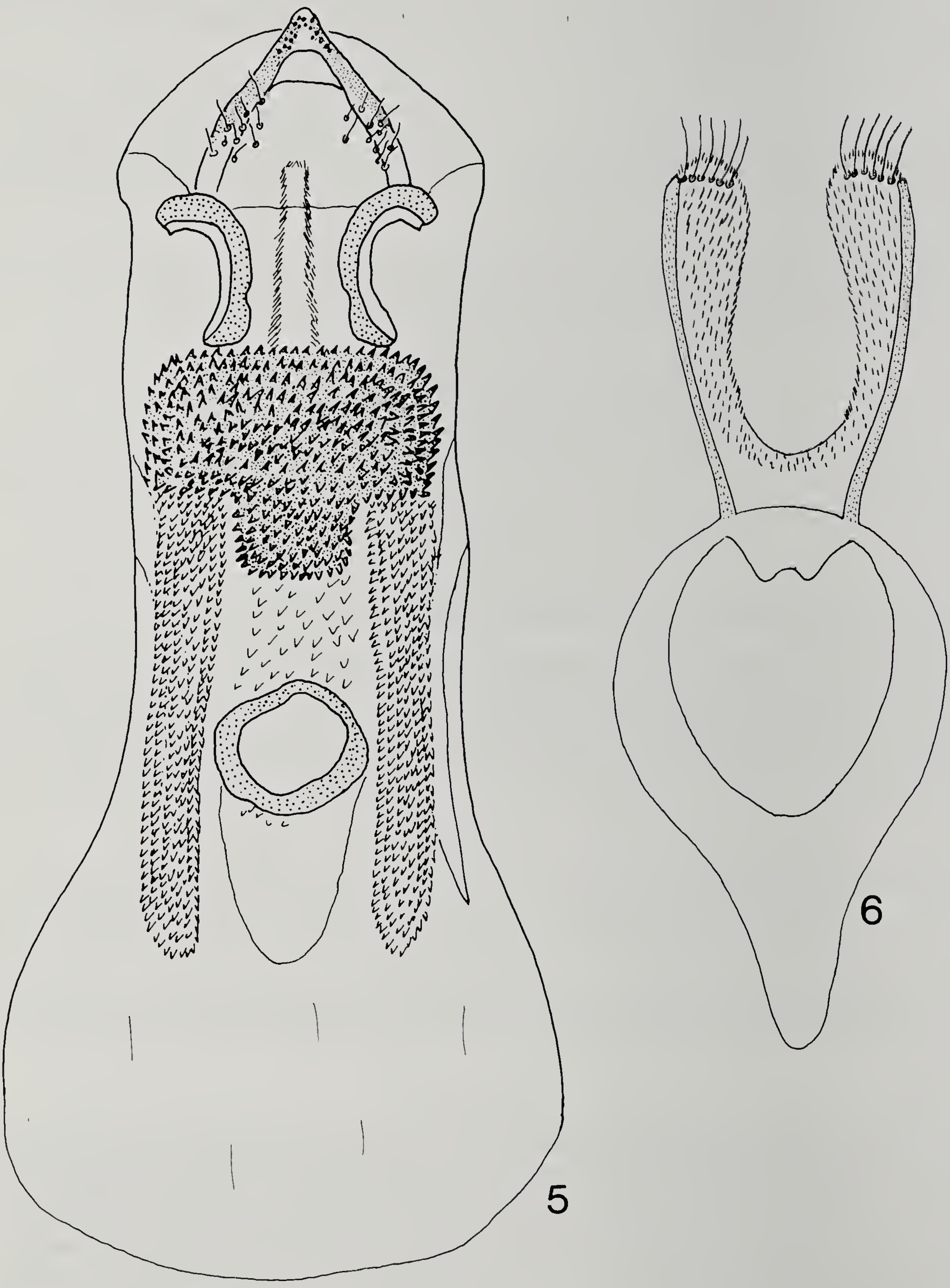
With recumbent white, brown, and golden hairs; *dark phase*: pronotum with intermixed brown and golden hairs on disk, dense patches of white hairs on median basal lobe and on either side between median lobe and lateral margin (fig. 7); lateral margins of pronotum with dense white hairs; elytron with intermixed golden and brown hairs except for line of moderately dense white hairs extending from base to apex between stria 2 and medial margin; pygidium with moderately dense, uniform white hairs, midline with very dense line of white hairs extending from base to apex; undersurfaces and legs with moderately dense to dense white hairs; *light phase*: similar to dark phase except elytron without brown hairs, white line of hairs along medial margin sparse but present (fig. 8).

Structure

Head.—Eyes slightly more prominent; ocular sinus about 1/2 as long as width of eye; antennal segments 1 and 2 usually moniliform, 3 and 4 usually filiform.

Prothorax.—Disk subcampanulate (figs. 7, 8); lateral prothoracic carina vague, extending about 2/3 distance from base to coxal cavity.

Mesothorax and Metathorax.—Scutellum small, quadrate; elytron about twice as long as broad; striae deep, punctate, strial intervals punctulate; striae 2, 3 and 4, and 5 and 6 closer to one another at base than to adjacent striae (figs. 7, 8); hind femur constricted basally and apically, expanded medially to about width of coxa (fig. 9); femur armed with an inner subapical acuminate spine slightly longer than

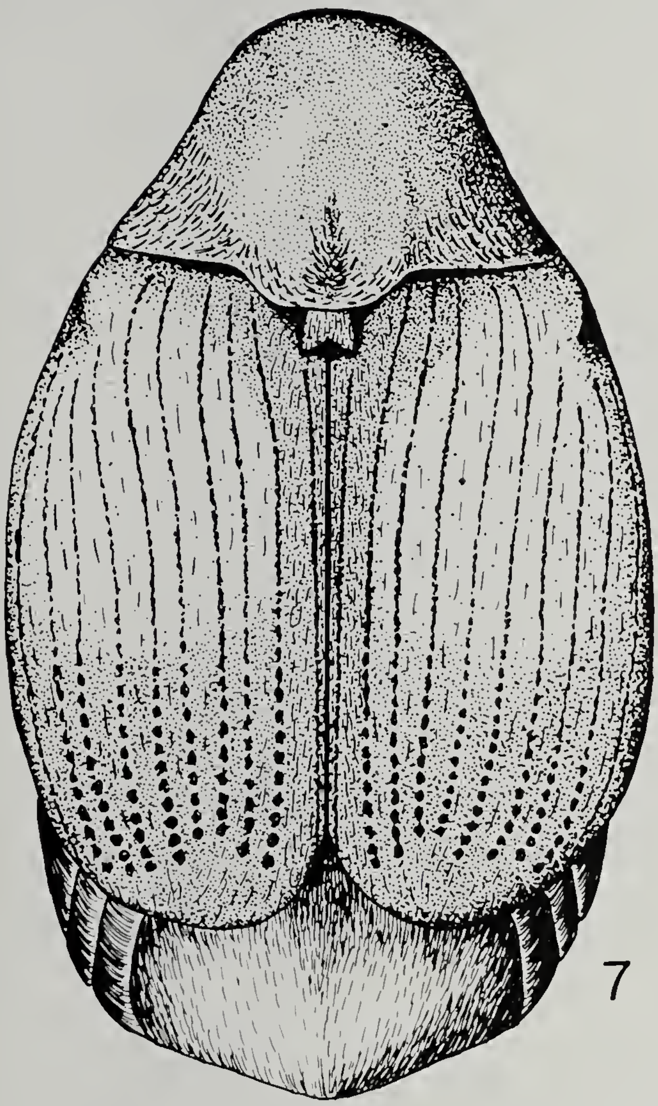


Figs. 5-6, *Sennius colima*, male genitalia: 5, median lobe; 6, lateral lobes.

width of tibial base, spine usually with 1 or 2 serrations on posterior margin; lateroventral carina of tibia usually absent, when present vague; mucro about 0.15 as long as 1st tarsomere.

Abdomen.—1st sternum about 2/3 as long as abdomen, posterior margin straight; 5th sternum deeply emarginate.

Genitalia.—Figs. 10, 11. Median lobe moderately long; in ventral view, ventral valve subtriangular, lateral margins concave, base about 1/2 as wide as apex of median lobe, arcuate in lateral view; hinge sclerites large, curved, broader at apex; armature of internal sac consisting of 2 medial clumps of small spines, 2 subtriangular elongated masses of spines (one on either side) near apex, a convoluted mass of spicules apically, and a rounded gonopore sclerite at apex. Lateral lobes expanded apically, cleft to about 0.66 their length (fig. 11).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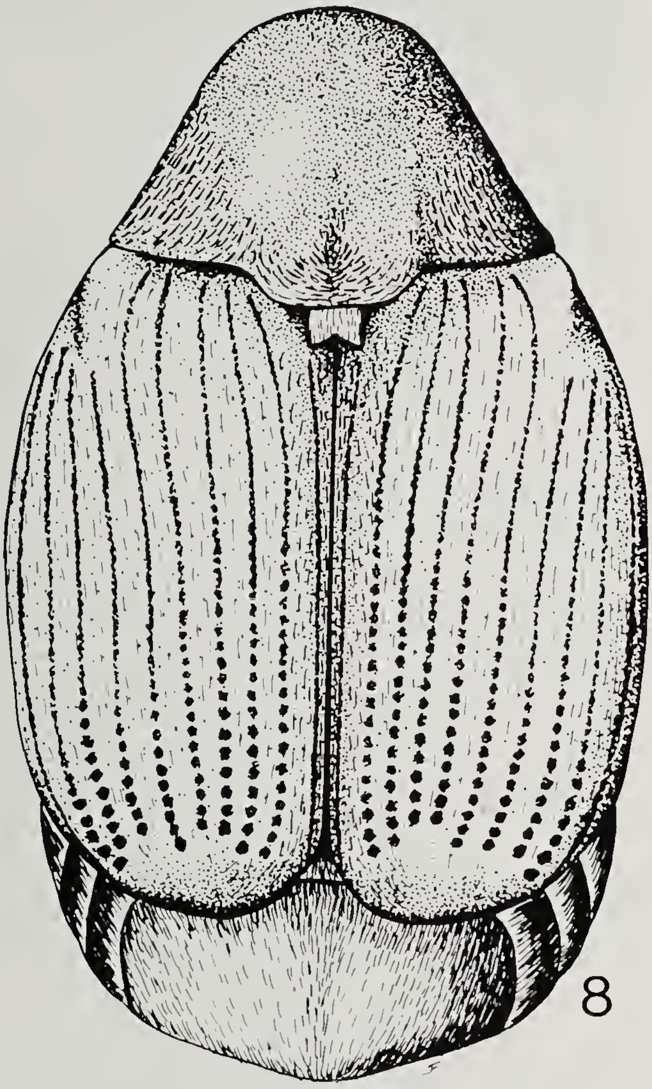
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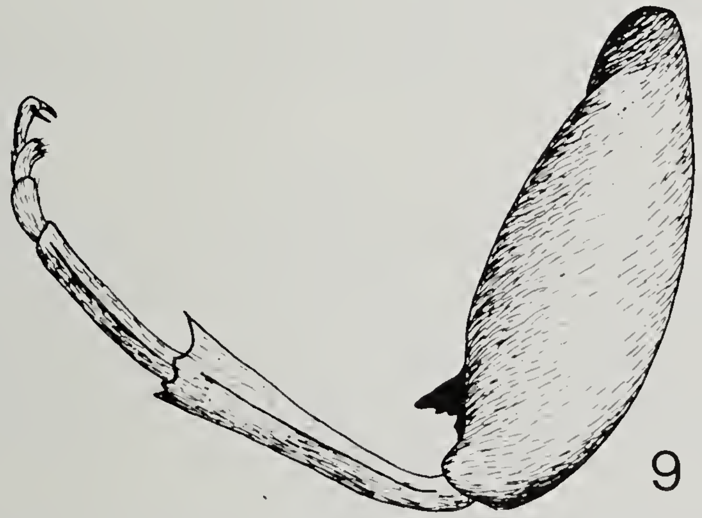
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Figs. 7-9, *Sennius lawrencei*: 7, habitus dark phase; 8, habitus light phase; 9, hind leg.

FEMALE

Apex of last abdominal sternum convex, about as long as 2 preceding sterna.

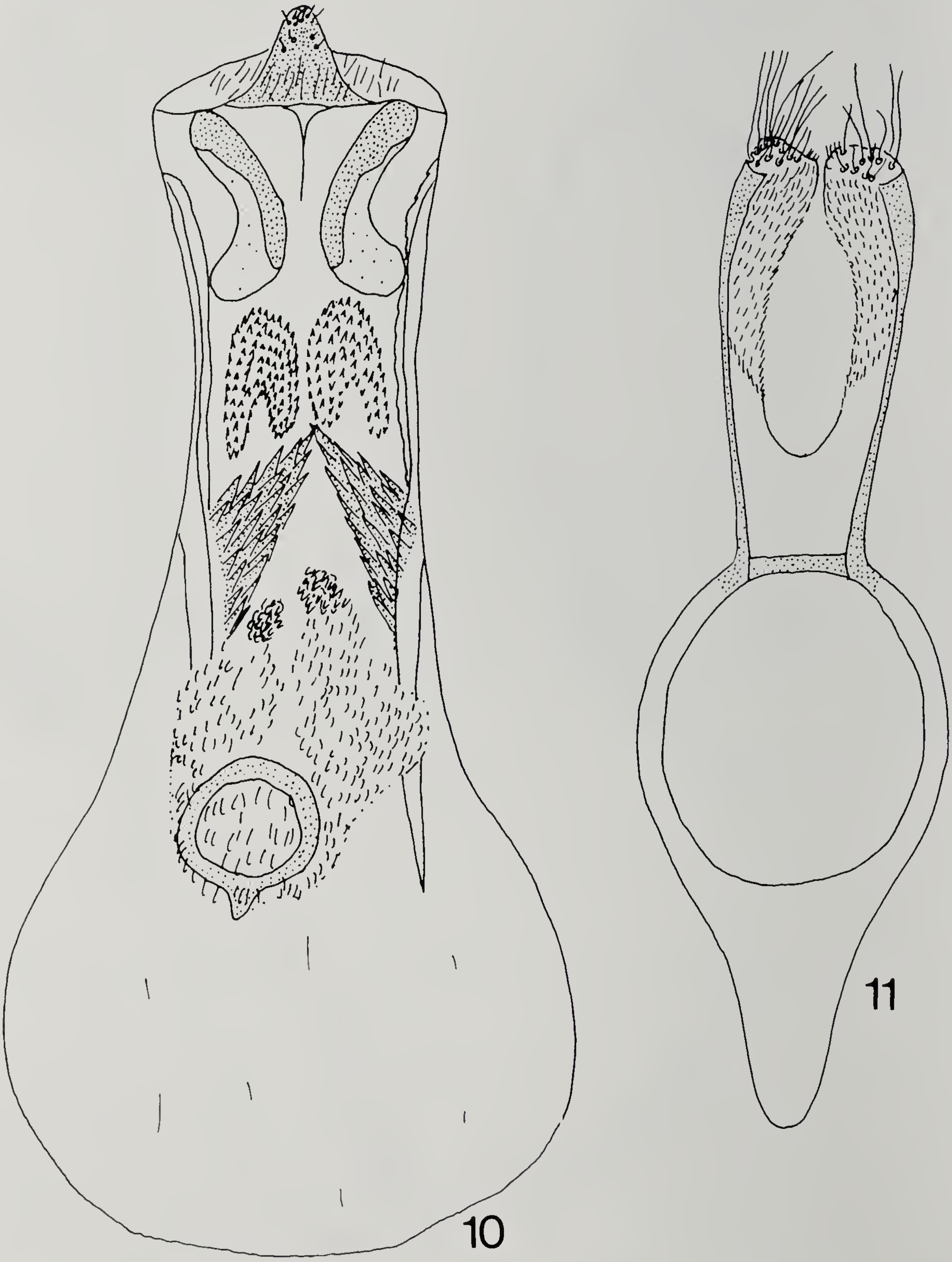
HOST PLANTS

Cassia sp.: Panama. Canal Zone: Rio Ciri Grande, 15-I-64, R. L. Dressler collector (LJB #119b).

Cassia reticulata Willdenow: Panama. Canal Zone: Frijoles, 24-I-64 (LJB #119g); Gatun, 3-III-64 (LJB #122c-A); Gamboa, 4-III-64 (LJB #122j).

TYPE SERIES

Holotype male, allotype female, and 101 paratypes: Panama. Canal Zone: Frijoles, 24-I-64, reared seeds *Cassia reticulata*, L. J. Bottimer collection #119g. CNC #15059. Numerous additional paratypes from localities listed under HOST PLANTS.



Figs. 10-11, *Sennius lawrencei*, male genitalia: 10, median lobe; 11, lateral lobes.

Holotype, allotype, and numerous paratypes deposited in the Canadian National Collection of Insects, Ottawa. Paratypes retained in the author's collection and also deposited in the following collections: California Academy of Sciences, San Francisco; Museum of Comparative Zoology, Harvard University, Cambridge, Mass.; and U.S. National Museum of Natural History, Washington, D.C.

Discussion

Sennius lawrencei is more similar to *S. instabilis* (Sharp) than to any other *Sennius* known to me. They resemble each other in color pattern and general overall morphology. However, *S. lawrencei* is larger; its elytral color is usually solid red orange, none having solid black elytra; the pygidium lacks 3 basal white spots; and the subapical acuminate spine on the femur is slightly longer than the width of the tibial base. The male genitalia are similar to those of *S. instabilis* but the internal sac of *S. lawrencei* has 2 medial clumps of small spines (compared to one clump in *S. instabilis*) and 2 subtriangular elongated masses of spines on either side near the apex (*S. instabilis* has 2 smaller, less well-defined clumps of spines near the apex). *S. lawrencei* keys to couplet 14 of Johnson and Kingsolver (1973). It is separated from *S. instabilis* by characters given above.

Because of its close relationship to *S. instabilis, S. lawrencei* is tentatively placed in species group 2 of Johnson and Kingsolver (1973), pending further systematic studies in *Sennius.*

This beautiful species at first appeared to be composed of 2 species, the dark form with red maculations on the elytra and the light form with all red elytra. However, except for color the external characters and male genital characters vary hardly at all, so I consider these forms to be members of the same species. Moreover, in 3 of the 4 rearings from seeds both color phases emerged, and the fourth rearing consisted of only one specimen!

S. lawrencei has been reared only from the seeds of *Cassia reticulata,* whereas *S. instabilis* has been reared from *Cassia occidentalis* and *C. uniflora* (Johnson and Kingsolver 1973).

This species is named for Lawrence J. Bottimer, collector of the species, and long time gatherer of bruchid host plant data.

Sennius panama Johnson, **new species**

(Figs. 3-4; 12-13)

Length (pronotum-elytra) 2.0-2.8 mm. Width 1.5-2.0 mm. Maximum thoracic depth 1.2-1.7 mm.

Male

Similar to *Sennius colima* but with the following exceptions:

Overall size smaller, less robust, elytral vestiture more contrasting.

Integument Color

Usually entire body reddish brown, with head, pronotum, thoracic sterna and hind coxa a darker reddish brown; apical 2/5 of elytron appears darker in color due to cover of sparse dark brown hairs (fig. 3); when occasionally thoracic sterna and hind leg very dark brown, then apical 2/5 of elytron appearing almost black.

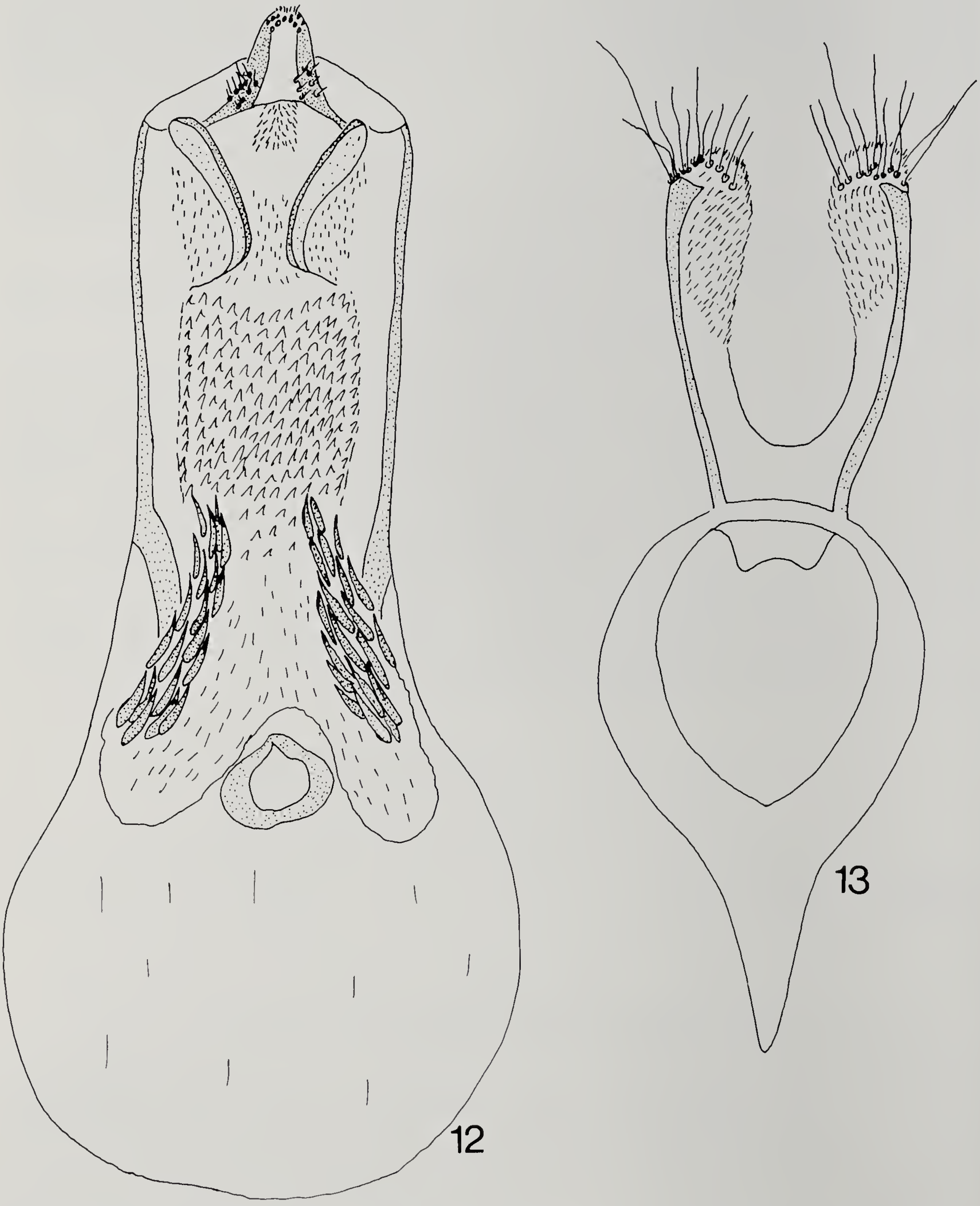
Vestiture

With recumbent yellow hairs predominantly; pronotum sometimes with dense line of hairs on midline with patches of dense hairs lateral to it and near base, usually without definite pattern; elytron often with dark hairs on apical 2/5 and with dense patches of yellow hairs in center so that a band of hairs reaches almost completely across elytron, interval between striae 7 and 8 never with dense yellow hairs.

Structure

Head.—Ocular sinus about 1/2 as long as width of eye.

Prothorax.—Fig. 3. Cervical sulcus shallow, extending from near coxal cavity to about 1/2 distance to pronotal midline; lateral prothoracic carina vague, extending about 2/3 distance from base to coxal cavity; prosternum separating procoxae for about 0.9 their length.



Figs. 12-13, *Sennius panama*, male genitalia: 12, median lobe; 13, lateral lobes.

Mesothorax and Metathorax.—Scutellum small, quadrate; striae deep, punctate (fig. 3); hind femur constricted basally and apically, expanded medially to about width of coxa (fig. 4); tibia with ventral, lateral, and dorsomesal glabrous longitudinal carinae, lateroventral carina well-marked at base but faint or obsolete at apex; tibial corona with about 3 spinules, mucro about 0.15 as long as 1st tarsomere.

Abdomen.—1st sternum about 2/3 as long as abdomen.

Genitalia.—Figs. 12, 13. Median lobe moderately long; in ventral view, ventral valve triangular, lateral margins arcuate, base about 1/2 as wide as apex of median lobe, arcuate in lateral view; hinge sclerites large, only slightly curved; armature of internal sac consisting of a large medial mass of spines, medial mass of spines connected to paired elongate strands of strong spines on either side of sac extending almost to apex; round gonopore sclerite at apex. Lateral lobes expanded apically, cleft to about 0.75 their length (fig. 13).

FEMALE

Dark brown line on interval between elytral striae 3 and 4 present.

HOST PLANTS

Cassia undulata Bentham: Panama. Canal Zone: Frijoles, 10-II-64 (LJB #120o); Salud Basin, near Frijoles, 8-III-64, N. G. Smith collector, (LJB #122m).

TYPE SERIES

Holotype male, allotype female, and 374 paratypes: Panama. Canal Zone: Frijoles, 10-II-64, reared seeds *Cassia undulata*, L. J. Bottimer collector, #120o. CNC #13912. Fourteen paratypes: Panama. Canal Zone: Salud Basin, near Frijoles, 8-III-64, N. G. Smith collector, L. J. Bottimer #122m.

Holotype, allotype, and numerous paratypes deposited in the Canadian National Collection of Insects (CNC), Ottawa. Paratypes retained in the author's collection and also deposited in the following collections: California Academy of Sciences, San Francisco; Museum of Comparative Zoology, Harvard University, Cambridge, Mass.; and U.S. National Museum of Natural History, Washington, D.C.

DISCUSSION

S. panama is closely related to *S. breveapicalis*, *S. colima*, and *S. lateapicalis*. Characters used to separate the 4 species are discussed under *S. colima*. The shape of the ventral valve of the male genitalia (figs. 5, 12) differs quite strikingly between *S. colima* and *S. panama*. These can be used as additional characters to separate the 2 species.

Elytral apices of most specimens of *S. panama* are a darker brown than the rest of the elytra and some are almost black. This variation does not seem to be correlated with variations in other characters.

Because of its close relationship to *S. breveapicalis, S. panama* is tentatively placed in species group 1 of Johnson and Kingsolver (1973), pending further systematic studies in *Sennius*. *S. panama* keys to couplet 7 of Johnson and Kingsolver (1973) and is separated from *S. breveapicalis* by characters given in the discussion of *S. colima*.

The specific epithet *panama* is a noun in apposition to *Sennius*.

NEW HOST AND LOCALITY RECORDS FOR SPECIES OF *Sennius*

Nineteen new host records for species of *Sennius* are presented below. These and the records listed for the new species are summarized in Tables

Table 1. Sennius *species and their host plants*
(Supplement to Johnson and Kingsolver 1973)

Sennius *spp.*	Cassia *host plant species*
auricomus	biflora; xiphoidea
breveapicalis	densiflora; undulata
colima	berlandieri
ensiculus	patellaria
fallax	berlandieri; bicapsularis; hintoni; occidentalis; reticulata
guttifer	bicapsularis; nicaraguensis
instabilis	biflora; leptocarpa; occidentalis; tora; uniflora
lawrencei	reticulata
leucostauros	bicapsularis
medialis	leptocarpa
militaris	emarginata
morosus	covesii; leptocarpa; occidentalis
obesulus	wrightii
panama	undulata
rufescens	bicapsularis; biflora; leptocarpa; occidentalis; reticulata; tora
simulans	leptadenia
trinotaticollis	maxonii; oxyphylla

Table 2. Plants infested by Sennius
(supplement to Johnson and Kingsolver 1973)

Cassia *host plant species*	Sennius *spp.*
berlandieri	colima; fallax
bicapsularis	fallax; guttifer; leucostauros; rufescens
biflora	auricomus; instabilis; rufescens
covesii	morosus
densiflora	breveapicalis
emarginata	militaris
hintoni	fallax
leptadenia	simulans
leptocarpa	instabilis; medialis; morosus; rufescens
maxonii	trinotaticollis
nicaraguensis	guttifer
occidentalis	instabilis; fallax; morosus; rufescens
oxyphylla	trinotaticollis
patellaria	ensiculus
reticulata	fallax; lawrencei; rufescens
tora	instabilis; rufescens
undulata	breveapicalis; panama
wrightii	obesulus
xiphoidea	auricomus
sp. (reticulata?)	fallax; rufescens

1 and 2. The locality records presented here supplement the records of Johnson and Kingsolver (1973) and Whitehead and Kingsolver (1975a).

It is of interest that those species of *Sennius* reported by Johnson and Kingsolver to have a wide range of hosts are shown to have many additional hosts. As would be expected, the converse is true for the bruchids with a narrow range; few new hosts are reported for them.

Sennius auricomus Johnson and Kingsolver

1. *Cassia biflora* Linnaeus: Mexico. *Sonora:* Lake Mocuzari, 24-XII-72 (CDJ #145-72); Lake Mocuzari, 22-XII-76 (CDJ #134-76); 2 mi S Lake Mocuzari, 22-XII-76 (CDJ #143-76); 8 mi S Lake Mocuzari, 22-XII-76 (CDJ #148-76); 5 mi W Alamos, 26-XII-76 (CDJ #184-76); 14 mi E Navojoa, 26-XII-76 (CDJ #188-76). *Sinaloa*: 4 mi S Culiacan, 26-XII-72 (CDJ #183-72); 33 mi S Escuinapa, 6-I-73 (CDJ #118-73).
2. *C. xiphoidea* Bertol. vel sp. aff.: Mexico. *Sinaloa*: 53 mi S Culiacan, 26-XII-72 (CDJ #189-72).

Sennius breveapicalis (Pic)

1. *C. densiflora* Mart. & Gel.: Mexico. *Guerrero*: Acapulco, January 1963 (intercepted in San Antonio, TX, LJB #113s).
2. *C. undulata* Bentham: Panama. El Valle, 18-XII-63 (LJB #117t); *Canal Zone*: Barro Colorado Island, 22-III-64 (LJB #120d).

Sennius ensiculus Johnson and Kingsolver

1. *C. patellaria* DC.: Panama. El Valle, 17-XII-63 (LJB #117s).
2. *Cassia (Chaemaecrista)* sp.: Panama. *Chiriqui*: Volcan de Chiriqui, 7-I-64 (LJB #118u).

Sennius fallax (Boheman)

1. *C. berlandieri* Bentham vel sp. aff.: Mexico. *Colima*: 7 mi E Manzanillo, 7-III-73 (CDJ #401-73).
2. *C. bicapsularis* Linnaeus: Mexico. *Colima*: 3 mi E Cuyutlan, 7-III-73 (CDJ #397-73); 4 mi NE Cuyutlan, 7-III-73 (CDJ #398-73); 1 mi W Manzanillo, 7-III-73 (CDJ #409-73). *Jalisco*: 2 mi NW Barra de Navidad, 8-III-73 (CDJ #427-73). *Sinaloa*: 3 mi N Los Mochis, 24-II-73 (CDJ #182-73).
3. *C. hintoni* Sandwith: Mexico. *Jalisco*: 22 mi N Barra de Navidad, 8-III-73 (CDJ #435-73); 56 mi S Puerto Vallarta, 9-III-73 (CDJ #452-73).
4. *C. occidentalis* Linnaeus: Mexico. *Colima*: 8 mi W Manzanillo, 8-III-73 (CDJ #413-73).
5. *C. reticulata* Willdenow: Panama. *Canal Zone*: Gatun, 3-III-64 (LJB #122c); Morgan Gardens near Ft. Clayton, 25-III-64 (LJB #122r-A).

Sennius guttifer (Sharp)

1. *C. bicapsularis* Linnaeus: Mexico. *Jalisco*: 8-III-73 (CDJ #427-73). *Sinaloa*: 6 mi N Los Mochis, 24-II-73 (CDJ #182-73).
2. *C. nicaraguensis* Bentham: Mexico. *Jalisco*: ca. 1200′, 18 mi N Barra de Navidad, 2-I-73 (CDJ #12-73).

Sennius instabilis (Sharp)

1. *C. biflora* Linnaeus: Mexico. *Sonora*: Lake Mocuzari, 24-XII-72 (CDJ #145-72); 5 mi W Alamos, 26-XII-76 (CDJ #184-76). *Sinaloa*: 4 mi S. Culiacan, 26-XII-72 (CDJ #183-72); 4 mi S Culiacan, 25-II-73 (CDJ #186-73).
2. *C. leptocarpa* Bentham: Mexico. *Colima*: 16 mi E Manzanillo, 2-I-73 (CDJ #39-73). *Jalisco*: ca. 3000′, 18 mi W Magdalena, 5-I-73 (CDJ #66-73). *Nayarit*: ca. 3500′, 24 mi NW Ixtlan Del Rio, 5-I-73 (CDJ #80-73). *Sonora*: 4 mi W Alamos, 25-XII-72 (CDJ #164-72); Lake Mocuzari, 22-XII-76 (CDJ #136-76); 8 mi NW Alamos, 23-XII-76 (CDJ #173-76); 1 mi W Alamos, 26-XII-76 (CDJ #176-76); 5 mi W Alamos, 26-XII-76 (CDJ #181-76).
3. *C. occidentalis* Linnaeus: Mexico. *Jalisco*: 4 mi N Barra de Navidad, 2-I-73 (CDJ #7-73). *Sinaloa*: 38 mi S Culiacan, 25-II-73 (CDJ #205-73). Nayarit: 10 mi NE Sayulita, 1-III-73 (CDJ #300-73). *Sonora*: 8 mi NW Alamos, 23-XII-76 (CDJ #172-76); 5 mi W Alamos, 26-XII-76 (CDJ #182-76).
4. *C. tora* Linnaeus: Mexico. *Colima*: 7 mi E Manzanillo, 7-III-73 (CDJ #403-73).

Sennius leucostauros Johnson and Kingsolver

1. *C. bicapsularis* Linnaeus: Mexico. *Colima*: 3 mi E Cuyutlan, 7-III-73 (CDJ #397-73); 4 mi NE Cuyutlan, 7-III-73 (CDJ #398-73); 1 mi W Manzanillo, 7-III-73 (CDJ #409-73). *Jalisco*: 2 mi NW Barra de Navidad, 8-III-73 (CDJ #427-73).

Sennius medialis (Sharp)

1. *C. leptocarpa* Bentham: *Arizona*. Cochise Co.: ca. 5000′, Ramsey Cyn. Rd. at Hwy. 90, 6-X-72 (CDJ #109-72); ca. 5500′, Carr Cyn., Huachuca Mts., 6-X-72 (CDJ #112-72). Pima Co.: ca. 4600′, mouth, Box Cyn., Santa Rita Mts., 7-X-72 (CDJ #129-72). Santa Cruz Co.: ca. 4200′, 3 mi NW Ruby, 15-X-76 (CDJ #71-76). Mexico. *Colima*: 16 mi E Manzanillo, 2-I-73 (CDJ #39-73).

Sennius militaris (Sharp)

1. *C. emarginata* Linnaeus: Mexico. *Colima:* 11 mi NE Armeria, 7-III-73 (CDJ #390-73). *Jalisco*: 21 mi N Barra de Navidad, 8-III-73 (CDJ #434-73).

Sennius morosus (Sharp)

1. *C. covesii* A. Gray: Mexico. *Sonora*: 0.5 mi W San Carlos Bay, 12-VIII-70 (CDJ #72-70); 17 mi S Navojoa, 13-VIII-70 (CDJ #99-70).
2. *C. leptocarpa* Bentham: Mexico. *Colima*: 16 mi E Manzanillo, 2-I-73 (CDJ #39-73). *Jalisco*: ca. 3000′, 18 mi W Magdalena, 5-I-73 (CDJ #66-73). *Nayarit*: ca. 3500′, 24 mi NW Ixtlan Del Rio, 5-I-73 (CDJ #80-73). *Sonora*: Lake Mocuzari, 22-XII-76 (CDJ #136-76); 8 mi NW Alamos, 23-XII-76 (CDJ #173-76); 1 mi W Alamos, 26-XII-76 (CDJ #176-76); 5 mi W Alamos, 26-XII-76 (CDJ #181-76).
3. *C. occidentalis* Linnaeus: Mexico. *Sonora*: 5 mi W Alamos, 26-XII-76 (CDJ #182-76).

Sennius obesulus (Sharp)

1. *Cassia wrightii* Gray: *Arizona*. Santa Cruz Co.: ca 4300′, 3 mi W Pena Blanca Lake, 15-X-76 (CDJ #58-76).

Sennius rufescens (Motschulsky)

1. *C. bicapsularis* Linnaeus: Mexico. *Nayarit*: 12 mi N Rosamorada, 12-VII-68 (CDJ #277-68). *Sinaloa*: 3 mi N Los Mochis, 24-II-73 (CDJ #182-73). *Colima*: 3 mi E Cuyutlan, 7-III-73 (CDJ #397-73); 4 mi NE Cuyutlan, 7-III-73 (CDJ #398-73); 1 mi W Manzanillo, 7-III-73 (CDJ #409-73). *Jalisco*: 2 mi NW Barra de Navidad, 8-III-73 (CDJ #427-73).
2. *C. biflora* Linnaeus: Mexico. *Sinaloa*: 4 mi S Culiacan, 25-II-73 (CDJ #186-73).
3. *C. leptocarpa* Bentham: Mexico. *Colima*: 16 mi E Manzanillo, 2-I-73 (CDJ #39-73). *Jalisco*: ca. 3000′, 18 mi W Magdalena, 5-I-73 (CDJ #66-73). *Nayarit*: ca. 3500′, 24 mi NW Ixtlan Del Rio, 5-I-73 (CDJ #80-73).
4. *C. occidentalis* Linnaeus: Mexico. *Colima*: 8 mi W Manzanillo, 8-III-73 (CDJ #413-73). *Jalisco*: 4 mi E Cihuatlan, 8-III-73 (CDJ #425-73); 4 mi N Barra de Navidad, 2-I-73 (CDJ #7-73). *Nayarit*: 13 mi S Rosamorada, 6-I-73 (CDJ #112-73); 10 mi NE Sayulita, 1-III-73 (CDJ #300-73). *Sinaloa*: 38 mi S Culiacan, 25-II-73 (CDJ #205-73). *Sonora*: 8 mi NW Alamos, 23-XII-76 (CDJ #172-76); 5 mi W Alamos, 26-XII-76 (CDJ #182-76).
5. *C. reticulata* Willdenow: Panama. *Canal Zone*: Gatun, 3-III-64 (LJB #122c); Morgan Gardens near Ft. Clayton, 25-III-64 (LJB #122r-A).
6. *C. tora* Linnaeus vel sp. aff.: Mexico. *Colima*: 7 mi E Manzanillo, 7-III-73 (CDJ #403-73).

Sennius simulans (Schaeffer)

1. *C. leptadenia* Greenm.: *Arizona*. Cochise Co.: ca. 5500′, Carr Cyn., 6-X-72 (CDJ #113-72).

Sennius trinotaticollis (Pic)

1. *C. maxonii* (Britt. & Rose) Schery: Panama. *Canal Zone*: Gamboa, 12-II-64 (LJB #120r).
2. *C. oxyphylla* Kunth. vel sp. aff.: Panama. *Canal Zone*: Gamboa, 12-III-64 (LJB #122p).

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* * *

NOTES ON *SILPHA INAEQUALIS* FABRICIUS (COLEOPTERA: SILPHIDAE)

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On 21 June 1971, at Fletcher, Henderson County, North Carolina, I noticed the bright flashes of what appeared to be sizeable metallic blue beetles flying about a carrion trap suspended from a tree limb. Upon investigation I found a few *S. inaequalis*, a small (10-12mm.), flat, dull black, carrion beetle, on the carrion or resting on the limb above it. I was puzzled to find nothing metallic about at all.

Suddenly a *S. inaequalis* answered my question. As it raised its elytra in preparation for flight, I noticed two unusual things. First, the elytra were not merely raised enough to allow deployment of the membranous wings—they were raised to the vertical and clapped together over the back like the wings of a resting butterfly, exposing the entire undersurface. Second, the exposed undersides of the elytra were bright metallic blue.

As the beetle flew, the vertically oriented elytra created the impression of a much larger insect while their reflective undersurfaces flashed metallic blue as they caught the light. Upon alighting and lowering the elytra the large metallic beetle suddenly vanished, leaving a small black one to mark the spot.

* * *

LITERATURE NOTICE

Etude sur les Erotylidae (Coleoptera) paléarctiques, by S. M. Iablokoff-Khnzorian. 1975. Acta Zool. Cracoviensia, 20(8):201-249, illus. Keys to subfamilies, tribes, genera, and species from the Palearctic. The fauna contains 19 genera and 111 species (33 in *Triplax* and 30 in *Tritoma*). Citations to original descriptions of senior and junior synonyms and general distributions are given. Illustrations show body form and distinctive markings.

—Anon.

COMPARATIVE DESCRIPTIONS OF THE FINAL LARVAL INSTAR OF *BRUCHUS BRACHIALIS, B. RUFIMANUS,* AND *B. PISORUM* (COLEOPTERA: BRUCHIDAE)

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Abstract

The final larval instars of *Bruchus brachialis* Fahraeus, *B. pisorum* (Linnaeus), and *B. rufimanus* Boheman are described and compared. Characters used are those of the antennae, clypeolabrum, epipharynx, mandibles, maxillae, labium, legs, spiracles, and anal sulcus.

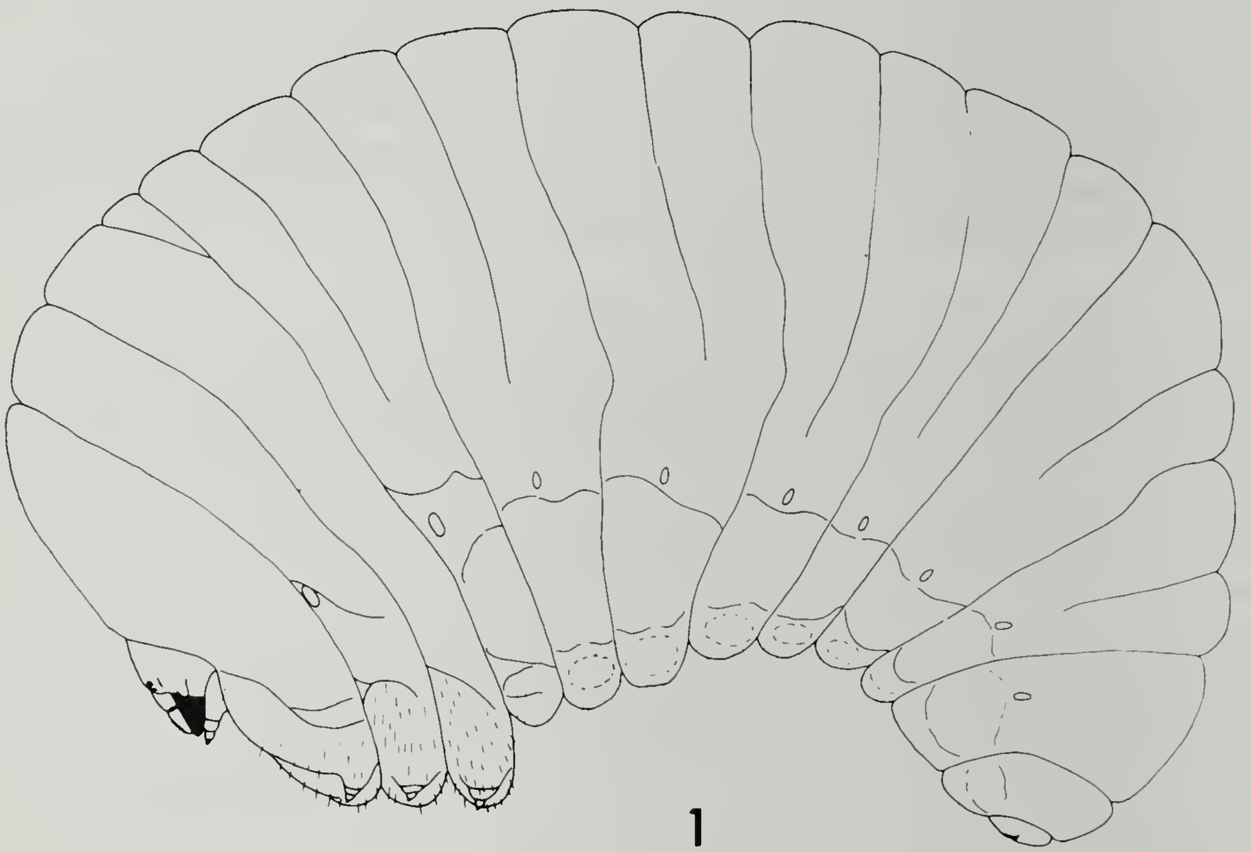
Bruchids are a group of seed beetles which infest primarily the seeds of leguminous plants (Johnson 1970). Of those plants attacked by bruchid larvae only a small percentage are of economic importance. Bruchids appear equally successful in parasitizing seeds in the field (Randolph and Gillespie 1958) or in storage (Howe and Currie 1964). In stored seeds, emerging females copulate and begin ovipositing one to several eggs on accessible seeds or pods, whereas in the field the overwintering adults fly to the fields where they initiate a new life cycle (Brindley and Chamberlin 1952). The eggs of these beetles are laid on the pod or seed surface and the emerging larva burrows into the underlying seed and subsequently devours the endosperm of one or more adjacent seeds.

These three species are of considerable economic concern. For example, all varieties of vetch are subject to attack by *B. brachialis*. However, the purple, wooly podded, and smooth or hairy vetches are so heavily parasitized that as many as 90% of the seeds have been destroyed in certain vetch growing regions. The adult female exhibits no preference for seeds in the field or in storage but is capable of infesting both. The contents of each vetch seed is sufficient to rear two or more developing larvae. The adults of *B. brachialis* are host specific as are the adults of *B. pisorum*. The effects of the latter species are, however, more frequently witnessed on green peas in the field rather than dry ones in storage. This fact appears not to have deterred its success however, for in pea growing regions of the northwestern U.S. losses due to *B. pisorum* have exceeded 70%. Of the three species discussed this species is unique in that rarely will there be more than one larva reared per seed (Campbell 1920).

B. rufimanus appears to differ biologically from the other two species, since it fails to exhibit host specificity for the broad bean and will readily infest the seeds of peas as well as vetch. In addition, as many as 16 larvae have been recovered from a single seed but normally two to three larvae mature per seed (Campbell 1920). Their ravage has also been extensive, for in certain areas of California as many as 65% of the broad beans have been destroyed.

The purpose of this paper is to provide the first comprehensive comparative descriptions of the final larval instar of the vetch bruchid (*B. brachialis*), the broad bean weevil (*B. rufimanus*), and the pea weevil (*B. pisorum*). A more descriptive account of the biology of these species may be found in Bridwell and Bottimer (1933) or Randolph and Gillespie (1958) for *B. brachialis,* in Brindley and Chamberlin (1952) for *B. pisorum*, and in Campbell (1920) for *B. rufimanus.*

I wish to thank J. M. Kingsolver, U.S. Department of Agriculture, for providing the larvae and C. D. Johnson for his invaluable editorial assistance.



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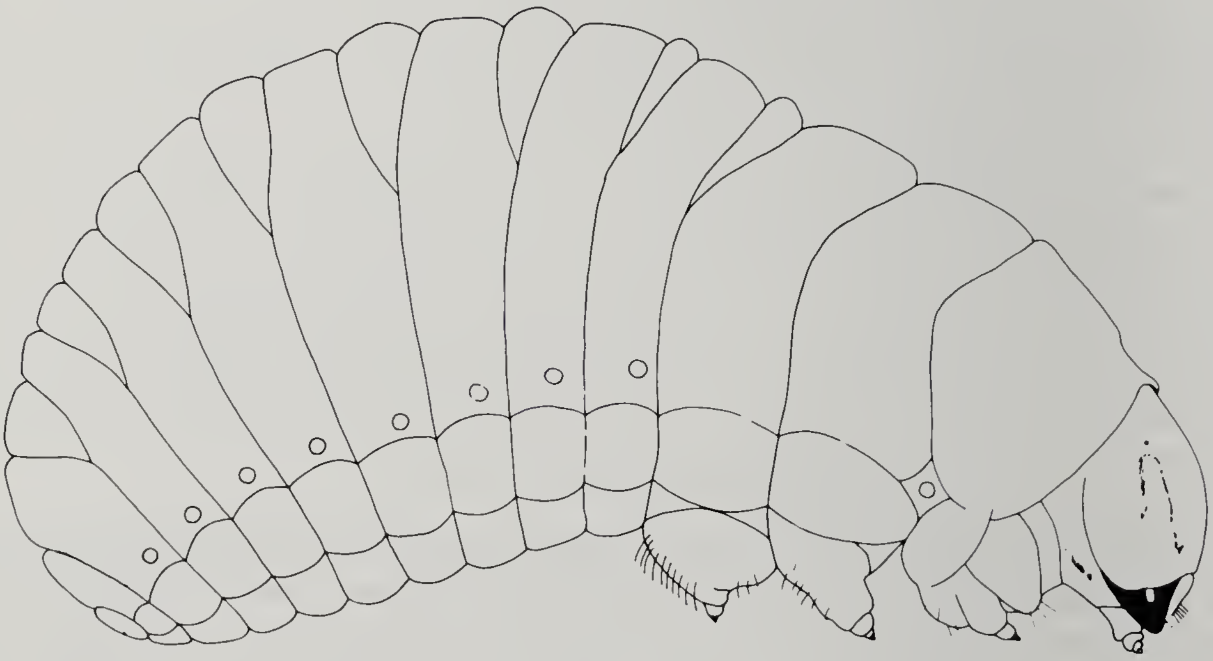

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Fig. 1, Larva, common lateral appearance of the three species. Fig. 2, Larva, occasional lateral appearance of *B. pisorum* and *B. rufimanus.*

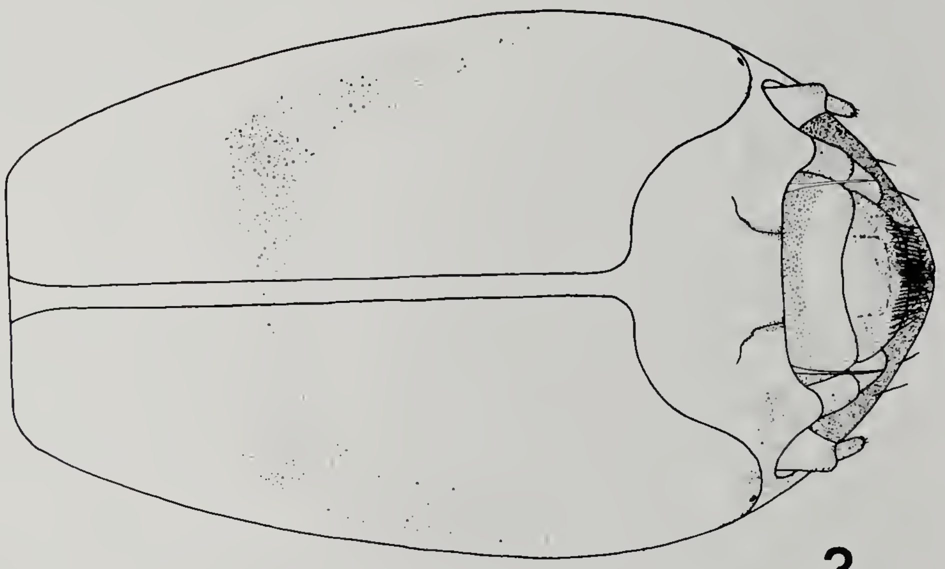
Bruchus brachialis Fahraeus

Characteristics of the final instar. *Body*: (Fig. 1) length 3.0-5.0 mm, C-shaped, robust, 1st thru 5th abdominal segments subequal, segments 6-10 strongly tapered posteriorly. Thoracic segments increasing in diameter posteriorly, metathoracic segment exceeding in diameter 1st abdominal segment. Cuticle white or yellowish, without sclerotization, setae restricted primarily to sternopleural regions, setae longest on thoracic sternites, tergal setae sparse, restricted to plical crests of larger abdominal segments. *Head*: (figs. 3, 4) retracted, oval, dorso-ventrally flattened, ventral surface (Fig. 4) occupied mostly by occipital foramen, light tan coloration, pigmentation concentrated near mouthparts. One ocellus located near base of each antenna, situated along anterior arms of lyre-shaped epicranial suture, with or without pigment. *Antenna*: (Fig. 5) located near base of mandible (Figs. 1, 3), 2-segmented; basal segment rectangular, 1/4 as long as distal segment, bearing sensory pore; distal segment quadrate, narrower to subequal in width with basal segment, each sensillum half the length of distal segment, sensilla subtended by 2 minute sensory papillae and 2 sensory setae. Large conspicuous seta located distally on terminal segment, setal length subequal to distal antennal segment. Sclerotized portion of terminal segment extended distally as sharp points. Projections sparse, arranged semi-circularly. *Clypeolabrum*: (Fig. 7) lightly pigmented, clypeal portion quadrate with concave anterior border, bearing 2 latero-medial setae, heavily pigmented, elongate oval area centrally located along clypeolabral border. Pigmented area bears pair of medially located sensory pores, sensory pores and setae located on labral side of clypeolabral suture. Margins of labral sclerite biconvex. Labrum with 3 equidistantly spaced setae arranged in arc situated midway between setal arc and anterolateral aspects of clypeolabral edge covered by dense setiferous mat. *Epipharynx*: (Fig. 6) biconvex, incomplete transverse sutures, 2 pair of opposed, strongly decurved setae located near distal end of shallow longitudinal depression. Dense rectangular mats of pointed asperities arranged obliquely on opposite sides of median depression. Four elongate blunt setae located in disto-medial arc, dense mat of subequal length setae extend distally to anterior border of epipharynx. *Mandible*: (Fig. 8) prognathous, monocondylic, cutting surface concave, smooth molar surface. *Maxilla*: (Fig. 9) with crescent-shaped cardo; stipes with quadrate base, bearing 11 setae on membranous region; palpifer with 2 setae embedded in sclerite, 1 mid-ventral, 1 anteromedial, small seta near latero-ventral edge of palpus; single segmented palpus, with 1 significantly larger than others; mala bearing 4 antero-medial peg-shaped setae. *Labium*: (Fig. 10) vestiges of submentum represented by median bar-shaped sclerite and lateral circular sclerites. Median sclerite bears 2 lateral short, stout setae, each spheroid sclerite supports 1 medially curved seta; mentum ovoid, flanked proximally by 2 setae, 2 setae in body of mentum each isolated in separate membranous pocket, fused glossae supporting 2 distal decurved setae each with sensory pore near base. *Legs*: (Fig. 11) distance between legs increasing with each succeeding segment, directed antero-medially, 4 segmented with 1 seta located distally on 3rd segment, segments tapering distally, terminating in small lobe-like distal segment. *Spiracles*: (Fig. 12) oval, mesothoracic and 1st abdominal pairs twice as large as remaining pairs, atrium with sclerotized projections appearing singly or in clusters of 2-3, projections few in number. Anus transverse, terminal.

Material Examined: 3 final instar larvae, Azores, 11-XI-62, from seeds of *Vicia* sp., collector unknown. Specimens provided by U.S. National Museum, Agricultural Research Division. Determined by association with reared adults.

Bruchus pisorum (Linnaeus)

Characteristics of the final larval instar. *Body*: (Fig. 1) length 2.5-5.0 mm, C-shaped, robust, subcylindrical, each succeeding thoracic segment of greater diameter, 1st thru 3rd abdominal segments subequal in diameter with increasing length posteriorly, 4th thru 6th abdominal segments nearly subequal with slight posterior taper, very pronounced taper exists with segments 7 thru 10, 10th segment button-like nearly concealed by segment 9. (An alternate body form was observed in a single specimen as seen in Fig. 2. The compactness of the protergites and other unusual contortions indicate this form may have been due to crowding during preservation.) Cuticle white to yellowish, without sclerotization, 2 vaguely yellowish pigmented areas on antero-dorsal aspects of prothorax. Setae nearly inconspicuous, restricted primarily to sterno-pleural regions, longest on thoracic sternites, sparse on all tergites restricted mostly to plical crests of larger abdominal segments. *Head*: (Figs. 3, 4) retracted (Fig. 1), oval, dorso-ventrally flattened, ventral surface (Fig. 4) occupied mostly by occipital foramen, light tan coloration, pigmentation concentrated near mouthparts primarily on mandibles. One ocellus located near base of each antenna, located along anterior arms of lyre-shaped epicranial suture, with or without pigment. *Antenna*: (Fig. 13) located at base of mandible (Figs. 1, 3), 2 segmented; basal segment transversly rectangular, of subequal width to distal segment, about 1/3 as long as distal segment; distal segment longitudinally rectangular, distal end occupied by single sensilla basiconicum and sensory seta, both of equivalent lengths, both slightly longer than basal segment, distal end of apical segment fringed with single row of narrow sclerotized projections, all of subequal length and 1/2 as long as sensillum which they surround. *Clypeolabrum*: (fig. 14) lightly pigmented, clypeal portion nearly rectangular in shape, proximal portion bordered by crescent-shaped pigmented area, lateral portions of pigmented area with 1 seta;



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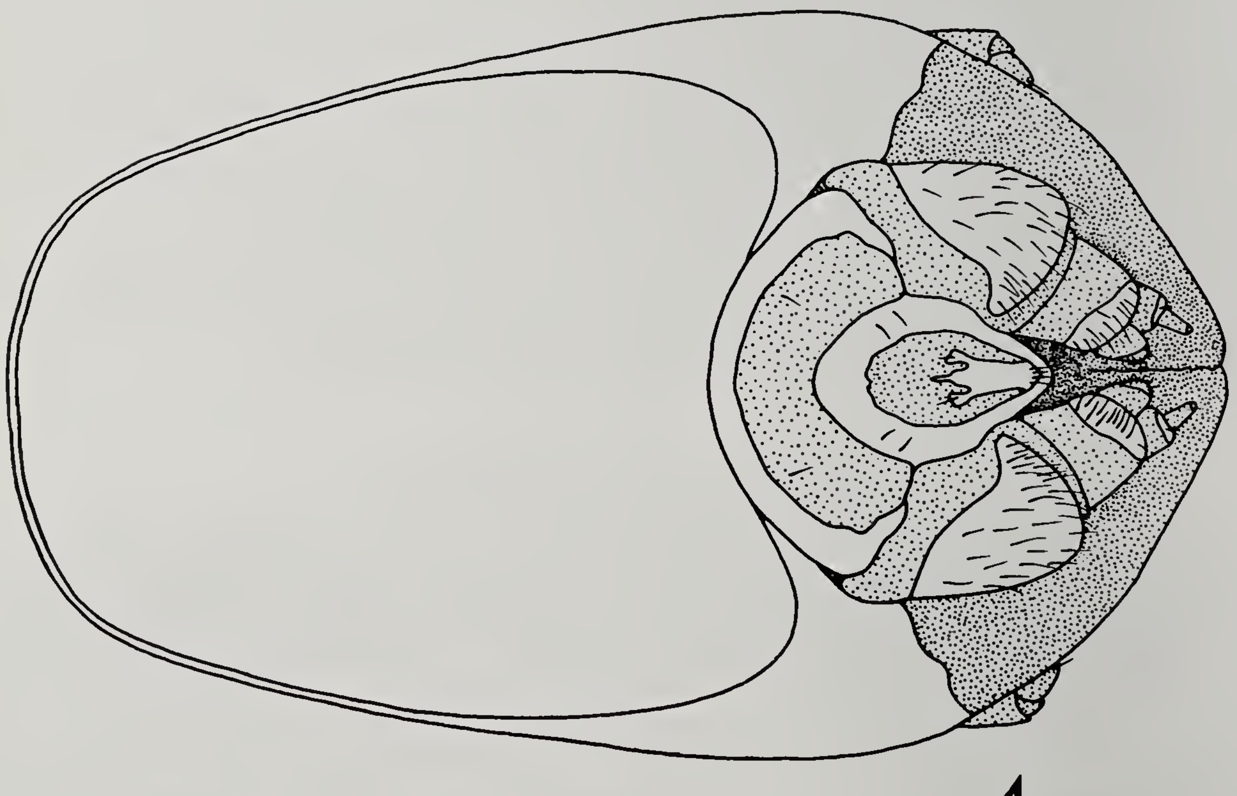

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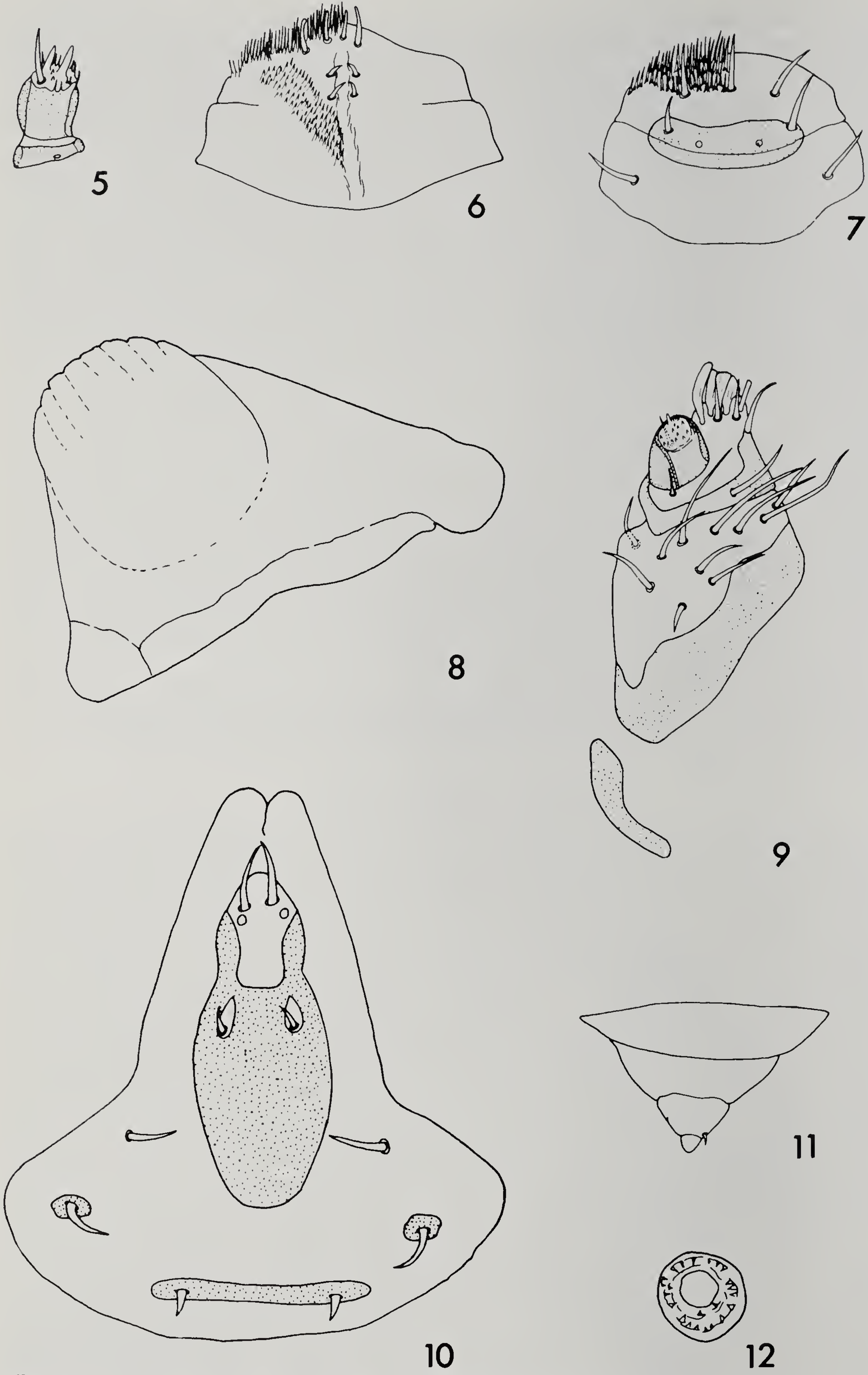
Fig. 3, Dorsal view of head capsule. Fig. 4, Ventral view of head capsule.

clypeolabral suture entire, overlapped by oval pigmented area, on labral side of suture are 2 centrally located sensory pores and 2 stout setae located antero-laterally of sensory pores; labrum bears distal arc of 5 peg-like setae, all subequal in length, 3 equidistantly spaced stout setae midway between arc of 5 setae and pigmented area, presence of 8 distal labral setae nearly obscured by dense setiferous mat extending over distal half of labrum. *Epipharynx*: (Fig. 15) evidence of transverse suture lacking, 2 pair of opposing, strongly decurved, short setae located antero-centrally; decurved setae bordered postero-laterally by bracket-shaped patches of dense, sharp sclerotized projections. *Mandible*: (Fig. 8) prognathous, monocondylic, cutting surface concave, smooth molar surface. *Maxilla*: (Fig. 16) with minute triangular cardo; sclerite of stipes with single ventro-laterally located seta, membranous area of stipes bearing 11 setae; sclerite of palpifer with seta and sensory pore located ventro-medially, membranous region of palpifer with 2 setae and sensory pore, 1 seta located laterad of palpus, other seta and sensory pore located ventro-medially near sclerite of palpifer, dorsal aspects of palpifer and mala covered by dense setiferous mat; palpus 1 segmented, bearing single dorsal seta, length of seta one-half as long as palpus, numerous chemo-sensory pegs of subequal length located distally; mala bearing 3-4 spatulate setae located antero-medially, 7 sharp, stout setae of varying lengths located near base of spatulate setae. *Labium*: (Fig. 17) submentum well developed, C-shaped, projecting laterally, bearing pair of short, sharp medially located setae, 2 pair of similar sized setae located laterally in membranous region between submentum and mentum; mentum with quadrate base and prong-like anterior projections, 2 setae in body of mentum isolated in membranous pockets; glossae fused, supporting pair of setae near ends of prong-like projections of mentum. *Legs*: (fig. 18) distance between legs increasing with each succeeding segment, directed antero-medially, 4 segmented, 2 small setae 1 base of distal segment, 1 near distal end of 3rd segment. *Spiracles*: (Fig. 19) oval, mesothoracic and 1st abdominal pairs twice as large as remaining pairs (Fig. 1), atrium with numerous sclerotized projections each appearing singly. Anus transverse, terminal.

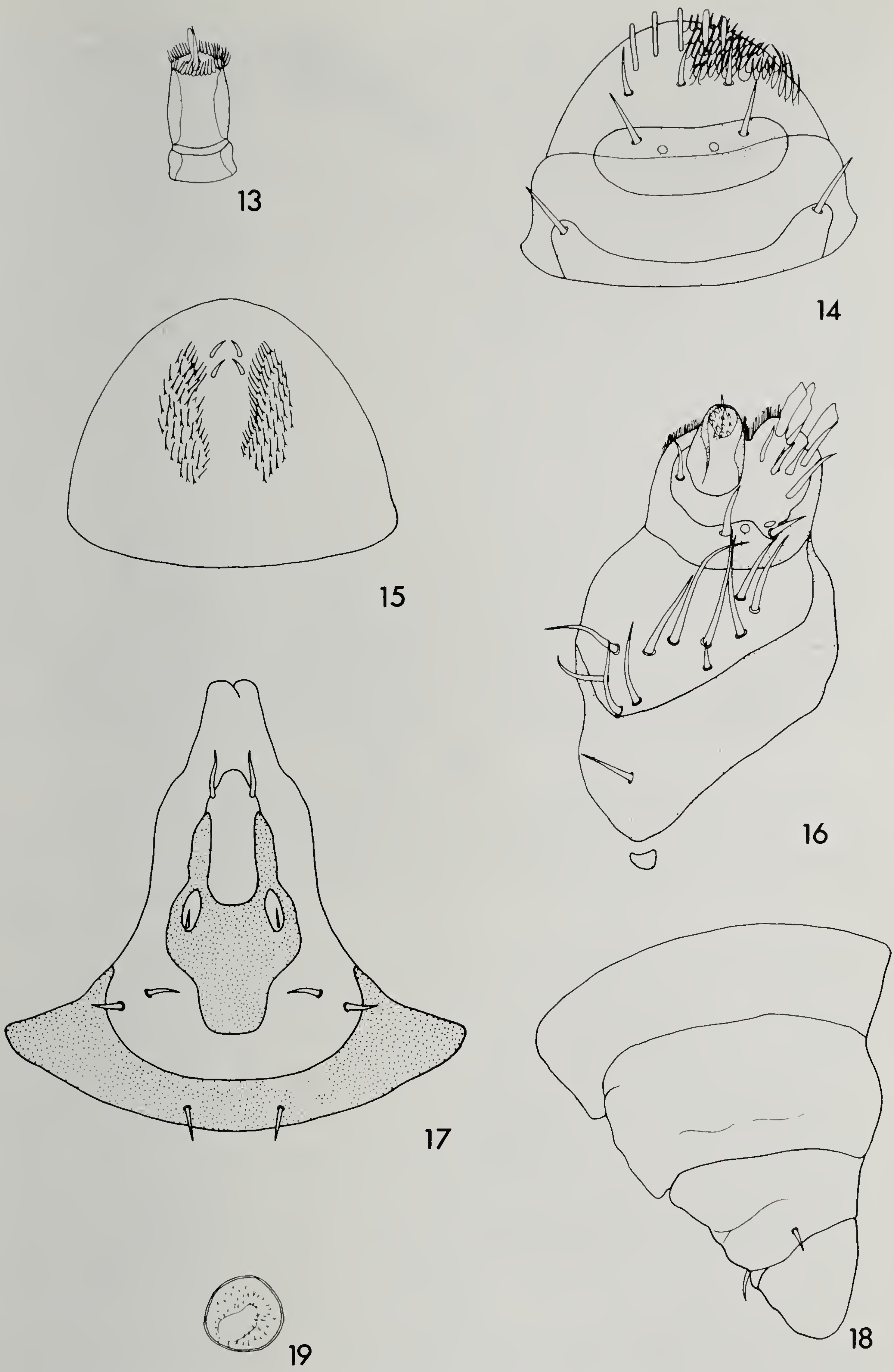
Material Examined: 6 final instar larvae, Cohocton, New York, 19-VIII-1897, from peas, W. L. Noble, collector. Specimens provided by U.S. National Museum, Agricultural Research Division. Determined by association with reared adults.

Bruchus rufimanus Boheman

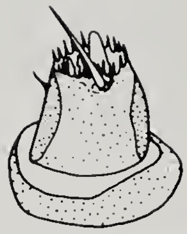
Characteristics of the final larval instar. *Body*: (Fig. 1) length 4-5.5 mm, C-shaped, robust, subcylindrical, each succeeding thoracic segment of greater diameter, 1st thru 3rd abdominal segments subequal in diameter with increasing length posteriorly, 4th thru 6th abdominal segments nearly subequal with slight posterior taper, pronounced taper exists with segments 7 thru 10, 10th segment button-like nearly concealed by segment 9. (The alternate body form seen in Fig. 2 was exhibited by two specimens. Its reliability is questionable and is probably due to movements or crowding during preservation.) Cuticle white to yellowish, without sclerotization, 2 vaguely yellowish pigmented areas on anter-dorsal aspects of prothorax. Setae nearly inconspicuous, restricted primarily to sternal some pleural regions, longest on thoracic sternites, sparse on all tergites restricted primarily to plical crests of larger abdominal segments. *Head*: (figs. 3 & 4) retracted (Fig. 1), oval, dorso-ventrally flattened, ventral surface (Fig. 4) occupied mostly by occipital foramen, light tan coloration, pigmentation concentrated near mouth-parts primarily on mandibles. One ocellus located near base of each antenna, situated along anterior arms of lyre-shaped epicranial suture, without pigment. *Antenna*: (Fig. 20) located at base of mandible (fig. 1); 2 segmented; basal segment flat, broad; apical segment nearly quadrate in appearance, two-thirds as wide as basal segment, distal end occupied by 2-3 chemosensory pegs and 1 large sensilla basiconicum, sclerite of distal segment terminating in fringe of sclerotized projections; distal segment bearing 2 setae, 1 subequal in length to distal segment located immediately outside fringe, 2nd seta 1/4 as long as distal segment located near apical end opposite larger seta. *Clypeolabrum*: (Fig. 21) lightly pigmented; proximal and distal borders biconvex; clypeolabral suture imcomplete, with slight lateral vestiges; clypeal portion without pigmented area, supporting 2 well-developed laterally located setae; elongate, oval pigmented region overlapping clypeolabral border, 1 seta located near lateral extremes of pigmented area, 1 pair of sensory pores located mesad of setae; labrum bears distal arc of 4 peg-like setae, proximal to these is 2nd arc of 3-pointed setae of variable lengths; distal arc nearly concealed by dense mat of setiferous-like



Figs. 5-12, Final larval instar of *Bruchus brachialis*: 5) antenna; 6) epipharynx; 7) clypeolabrum; 8) mandible; 9) maxilla; 10) labium; 11) leg; 12) spiracle.



Figs. 13-19, Final larval instar of *Bruchus pisorum*: 13) antenna; 14) clypeolabrum; 15) epipharynx; 16) maxilla; 17) labium; 18) leg; 19) spiracle.



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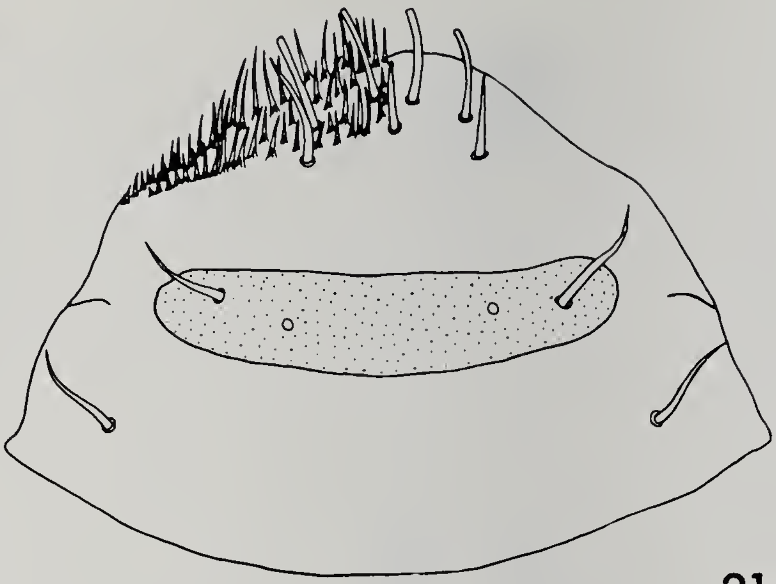

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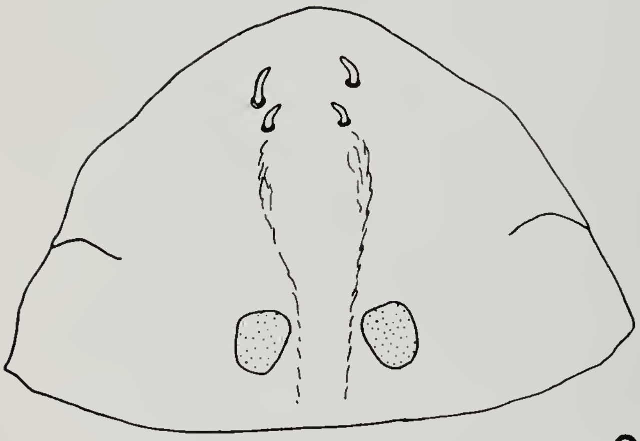

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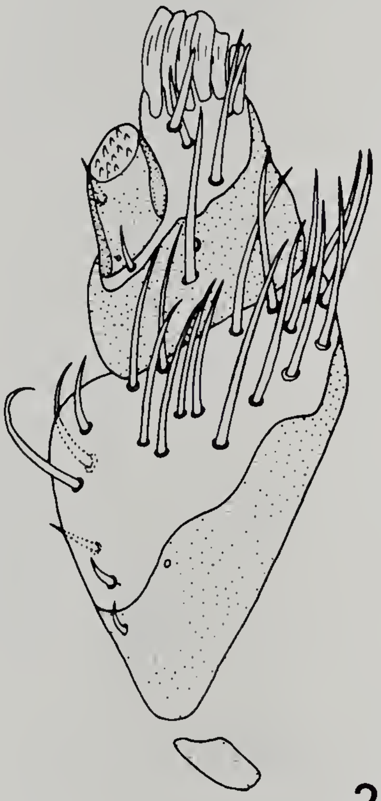

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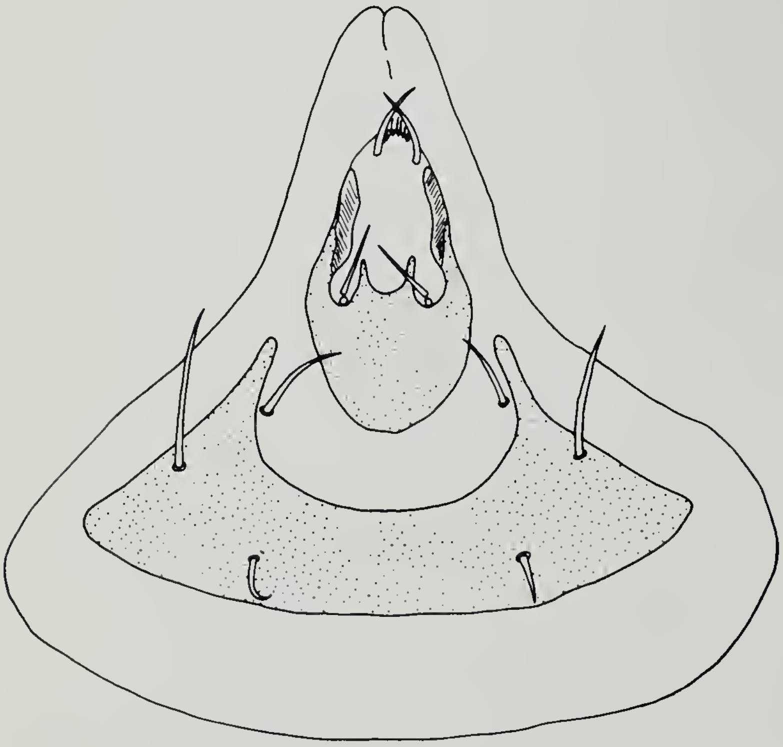

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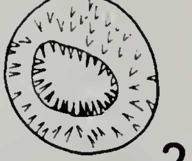

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Figs. 20-25, Final larval instar of *Bruchus rufimanus*: 20) antenna; 21) clypeolabrum; 22) epipharynx; 23) maxilla; 24) labium; 25) spiracle.

sclerotized projections, projections of varying lengths. *Epipharynx*: (Fig. 22) short lateral vestiges represent transverse suture; 2 small, circular, pigmented patches located proximally and laterad of median groove; median trough bordered by fine setae, trough flares apically; 2 pairs of opposing, decurved, short setae near distal end of trough. *Mandible*: (Fig. 8) prognathous; monocondylic; cutting surface concave; smooth molar surface. *Maxilla*: (Fig. 23) cardo minute with quadrate base and acuminate latero-distal end; stipes triangular, sclerite with undulating anterior border, small decurved seta and sensory pore embedded in ventral antero-lateral portion of sclerite, membranous region of stipes with 20 well developed setae of varying lengths; palpifer with single, elongate seta and sensory pore embedded in ventro-median aspects of sclerite, membranous region with 4 setae, 1 at ventral base of palpus, 3 between base of palpus and mala, of these 2 appear dorsad and near base of spatulate setae on mala; mala with 5-6 spatulate setae, 1 peg-like located lateral to ventral spatulate seta; palpus with single, short setae on dorso-medial area of sclerite, 1 latero-ventral sensory pore, numerous distal, conical sensillae of subequal lengths. *Labium*: (Fig. 24) triangular shaped; submentum well developed, anterior border C-shaped, sclerite with 2 latero-distal points, 4 setae, 2 short of proximo-medial location, 2 long, latero-distal in location, 2 setae of median length located near ends of C-shaped anterior border in membranous region between submentum and mentum; mentum with ovoid base, anterior arms appear twisted, pockets in mentum base partially enclosed, each pocket with seta and proximal sensory pore; glossae fused with 2 apical, decurved setae of median length, numerous, smaller setae, less than half their length anterior to base of decurved setae. *Legs:* (Fig. 18) distance between legs increasing with each succeeding segment, directed antero-medially, 4 segmented, 2 small setae 1 at base of distal segment, 1 near distal end of 3rd segment. *Spiracles*: (fig. 25) oval if body shape as in Fig. 1, round if body shape as in Fig. 2; atrium with numerous sclerotized projections of irregular arrangement. Anus transverse and terminal.

Material Examined: 3 final instar larvae, Tangier, Morocco, 3-IX-32, from seeds of the broad bean, collector unknown. Specimens provided by U.S. National Museum Agricultural Research Division. Determined by association with reared adults.

DISCUSSION

The 3 species described in this paper are rather easily distinguished by features of the antenna, clypeolabrum, epipharynx, and labium. The chaetotaxy, shape of the cardo, and features of the maxilla may be of intermediate value, whereas features of the legs and spiracles appear to be of little significance.

The antenna of *B. brachialis* (Fig. 5) is distinguished by the presence of 2 elongate sensilla basiconica located on the apical end of segment 2. Both sensilla are of equivalent size and are slightly more than 1/2 as long as the associated elongate seta. This species also lacks a complete circumscribing row of pointed asperities at the distal end of segment 2, a feature characteristic of *B. pisorum* and *B. rufimanus*. Both antennal segments of *B. pisorum* (Fig. 13) are subequal in width, whereas *B. rufimanus* (Fig. 20) has a broad, flat basal segment half again as wide as the distal segment. Both *B. pisorum* and *B. rufimanus* bear distally an elongate sensillum basiconicum and seta. However, in *B. pisorum* these are of subequal lengths and arise from contiguous bases, whereas the distal seta of *B. rufimanus* is located outside the encircling asperities and is approximately twice as long as the terminal sensillum.

The clypeolabrum of *B. pisorum* (Fig. 14) is distinguished by the crescentric pigmented region at the base of the clypeal plate. *B. pisorum* and *B. rufimanus* (Fig. 21) bear distally a double arc of blunt setae, a feature not observed in *B. brachialis* (fig. 7). There are 5 setae in the distal arc of *B. pisorum* and only 4 in *B. rufimanus*.

The epipharynx of each species is quite distinctive and is of considerable value in species identification. *B. brachialis* (Fig. 6) bears distally an arc of decurved, blunt setae. A dense setiferous mat extends beyond the setal arc and conceals the distal edge of the epipharynx. *B. brachialis* and *B. pisorum* (Fig. 15) possess 2 patches of pointed asperities. Those of *B. brachialis* are arranged obliquely and present a V-appearance, whereas those of *B. pisorum* are crescent-shaped and present a ()-appearance. A trough like median depression exists along the longitudinal median axis of *B. brachialis*, where it is uniformly narrow, and *B. rufimanus* (Fig. 22), where it undergoes a distolateral expansion and does not pass between the 2 pair of decurved setae as it does in *B. brachialis*. The 2 semicircular, sclerotized, pigmented areas flanking the proximal portion of the median depression of *B. rufimanus* are distinctive.

The most useful traits of the maxilla are those associated with the cardo and the chaetotaxy of the stipes. The boomerang-shaped cardo of *B. brachialis* (Fig. 9) is significantly more developed than that of the other two species. The well-developed cardo is of particular value in distinguishing this species from *B. pisorum* (Fig. 16) since both bear approximately 11 setae on the membranous region of the stipes. Neither species resembles *B. rufimanus* (Fig. 23) in this respect since the latter possesses 20-21 stipeal setae. However, the sclerite of the stipes supports a seta near its base in both *B. pisorum* and *B. rufimanus* but not in *B. brachialis*. The number of setae associated with the spatulate forms on the mala may also represent a character of high priority; *B. brachialis* and *B. rufimanus* bear 2-4 setae whereas *B. pisorum* bears 6-8 setae.

The taxonomic significance of the labium compares with that of the epipharynx. The vestigial nature of the submentum of *B. brachialis* (Fig. 10) differentiates it from the other two species. *B. pisorum* (Fig. 17) is distinguished by the presence of 2 pairs of setae in the membranous region between the mentum and submentum. Furthermore, the submentum of *B. pisorum* is more extensive, spanning the full width of the labial base. *B. rufimanus* (Fig. 24) is distinguished by its well-developed submentum bearing 2 pairs of setae, and it lacks the isolated membranous islets within the mentum characteristic of the other two species. The presence of 3-5 small, erect setae (nearly concealed by the convergent, overlapping, larger pair) at the distal end of the mentum may also be useful in distinguishing the broad bean weevil.

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OBSERVATIONS ON THE BEHAVIOR OF *PHILONTHUS ALUMNUS* ER. (COLEOPTERA: STAPHYLINIDAE, STAPHYLININAE)

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Abstract

Specimens of *Philonthus alumnus* Er., collected at blacklight in Bryan, Texas, were maintained in laboratory cultures. This beetle proved to be an aggressive predator on several small insects including *Drosophila melanogaster*, *Sinella curviseta*, *Heliothis zea* (1st instars), as well as other individuals of *P. alumnus*. Grooming behavior primarily consisted of unilateral rubbing acts in which the goal was to pass detritus anteriorly to the mouth for ingestion. Much of the grooming behavior appeared instinctive, but the beetle was able to make some adjustments if grooming structures were missing. The mating sequence was short with no elaborate displays; the male assumed an active role, while the female assumed a (for the most part) passive role.

Introduction

In America north of Mexico the genus *Philonthus* Curtis contains more than 140 species (Moore and Legner 1975). Little work has been done on the general biology and ecology of these species, and the systematics of the group is primarily in the descriptive phase. Many *Philonthus* species are commonly listed (usually as "*Philonthus* sp.") as predators of dung inhabiting flies (Bacchus and Hammond 1972, McDaniel *et al.* 1971, Merritt 1976, Sanders and Dobson 1966, and Wingo *et al.* 1974). Hinton (1954) briefly described the habits and general ecology of *P. sordidus*, *P. politus*, and *P. succicola*, all of which are predaceous on fly larvae. However, no reference to the habits or ecological characteristics of *Philonthus alumnus* Er. is made in these works.

According to J. M. Campbell (pers. comm.), *P. alumnus* is one of the most abundant species of *Philonthus* in North America. Moore and Legner (1975) list *P. alumnus* from New York, Florida, Missouri, Baja California, Arizona, S. California, and the West Indies, and Blackwelder (1944) also lists it from Mexico and Puerto Rico. *P. alumnus* occurs commonly in east-central Texas throughout the late spring and summer. Since I have been unable to find any account of the biology of this beetle, the present paper describes a series of behavioral observations which I have made under laboratory conditions.

Materials and Methods

Twenty-four specimens of *Philonthus alumnus* Er. were collected at blacklight in Bryan, Texas on May 14, 1976. The beetles were placed in a small plastic bowl (10.5 cm diameter X 5.0 cm high) containing a moist sand substrate. A tight fitting clear plastic lid was affixed to this chamber. The beetles were maintained in an incubator at 20° C and were fed *Drosophila* larvae as food. Most behavioral observations were made by placing the entire chamber under a dissecting microscope. Individual beetles were removed to smaller plastic chambers (5.5 cm diameter X 4.0 cm high) for observation of grooming behavior. A moist strip of white paper toweling was placed in each smaller chamber to facilitate observation and to serve as a substrate. Chalk dust or charcoal powder was then sprinkled with a small camel's hair brush on the dorsal surface of the beetles to induce grooming.

OBSERVATIONS ON BEHAVIOR

The beetles spent most of their time roaming around the chamber (presumably in search of prey), or resting in sheltered areas such as burrows which they had formed in the sand or under small pieces of wood or rock. Unlike some predaceous staphylinids (*i. e.* many *Stenus* species) *P. alumnus* did not appear to be gregarious, the individuals maintaining as much distance as possible between themselves in the chamber. When contact between individuals was made, a minor bout of fighting often occurred.

Aggressive Behavior. Individuals of *P. alumnus* were highly aggressive towards one another. Contact occurred often in the chamber causing the beetles to chase, and on several occasions, battle one another. Most bouts were short, the attacked individual usually retreating. These fights normally lasted for only a few seconds, but occasionally lasted for ca. 2-3 minutes. The killing of one individual by another was never observed. However, in an earlier trial 4 specimens were placed in a small plastic chamber with no food supply. Two days later only 2 beetles were alive, and remains of the other 2 (legs, individual sclerites, elytra, etc.) were found scattered on the floor of the chamber. The following day only 1 individual was found alive. Thus it appears that *P. alumnus* may resort to cannibalism under crowded conditions in the absence of food.

Feeding Behavior. In the laboratory several small insects were accepted as food. These included *Drosophila melanogaster* Meigen (larvae, pupae, and adults), *Heliothis zea* (Boddie) (1st instar larvae), and a collembolan, *Sinella curviseta* Brook.

D. melanogaster larvae (all instars) were readily accepted as food and adult *P. alumnus* have been maintained on this diet for nearly 3 months. Depending on the size of the larva, complete ingestion took ca. 2-5 minutes. Intact pupae of *D. melanogaster* were accepted, but injured pupae (*i. e.* pierced with a dissecting needle, allowing the hemolymph to exude) were more readily accepted. *D. melanogaster* adults were eaten, but these were difficult for the beetles to capture; the entire insect (excluding wings and legs) was masticated and ingested. First instar *H. zea* larvae were readily accepted and completely ingested by *P. alumnus*. *S. curviseta* individuals were difficult to capture unless injured or, on rarer occasions, trapped by the beetles. However, when captured, the entire springtail was ingested. From these experiments it appears that *P. alumnus* will accept a variety of small, soft bodied insects as food.

Upon capturing its prey, *P. alumnus* quickly retreated to a secluded spot; however this behavior may be abnormal due to the crowded conditions in the chamber. On many occasions, individuals would attempt to arrest food from one another, leading to a violent food "tug-of-war". This behavior usually involved only 2 individuals, but occasionally 3 beetles would compete for the same food morsel. This activity led to pulling the food apart, each beetle retreating to a secluded spot with a small portion.

Mating Behavior. Mating of *P. alumnus* was observed on 6 different occasions. This consisted of a sequence of events in which the male assumed an active mode while the female assumed, for the most part, a rather passive role. The preliminary phase of the mating sequence was brief, lasting for several seconds only, while the genital phase lasted ca. 4 minutes. The post-copulatory sequence was initiated when the genitalia were unlocked and the male and female lost physical contact with one another. The sequence of events included in mating behavior of one pair of beetles is listed in Table 1.

The preliminary phase in the mating sequence consisted of what appeared as an attack on the female by the male. The male rushed toward the female and tried to mount her dorsally, while the female gave every indication of trying to escape.

The genital phase began when the male was successful in mounting the female, who at this time assumed a very passive role as the genitalia were coupled. Afterwards, the male stepped off the female and assumed an end-to-end posture with her. In this position the male's abdomen was twisted, but he was still able to maintain a normal up-right stance. This posture was maintained for ca. 4 minutes as the male slowly and rhythmically undulated his abdomen, and the female continued her passive demeanor.

The post-copulatory phase usually contained grooming movements (rubbing the abdomen with the legs and oral grooming of the antennae and forelegs) by the male. Only rarely did the female exhibit grooming as a part of the post-copulatory sequence, as she most often retreated to a secluded spot and continued to feed (mating was observed only when the female was feeding).

Grooming Behavior. Grooming behavior is here used in the same context as developed by Valentine (1973). The term "clean" refers to patterns whereby an appendage is passed over the mouthparts (oral grooming), and the term "rub" refers to patterns involving the scraping of a leg over another appendage or body region. Thus, grooming behavior can be loosely defined as the action whereby particulate matter is removed from the body or an appendage through stereotyped cleaning and/or rubbing movements. In *P. alumnus* several grooming patterns were observed, the object of which was to pass detritus to the mouthparts for ingestion.

Cleaning. Except in rare situations, the only structures groomed via the mouthparts were the forelegs (tibia and tarsus only) and the antennae. The antenna was brought to the mouth by reaching foreward with the ipsilateral foreleg, placing the tarsus on top of the base of the antenna, and retracting the leg to its normal position. This action brought the basal segments of the antennae near the mouthparts allowing them to be grasped by the mandibles and maxillae. The antennae was cleaned from about segment 2 to the apex by pulling it through the mouthparts as the mandibles and maxillae worked in a chewing motion. The foretarsus and foretibia were cleaned by rapidly pulling them across the mouthparts, which again worked in a chewing motion. Only unilateral (one appendage at a time) cleaning was observed in *P. alumnus.*

	Female	Male
Preliminary Phase	1. Feeding in Open	
		2. Hiding in Crevice
	3. Walked Near Male	
		4. Appeared to Attack
	5. Attempted to Escape	
Genital Phase		6. Dorsally Mounted Female
	7. Stood Still, Continued Feeding	
		8. Locked Genitalia
	9. Stood Still, Continued Feeding	
		10. Dismounted, Assumed End-to End Posture with Abdomen Twisted
	11. Stood Still, Continued Feeding	
		12. Slowly Undulated Abdomen
	13. Stood Still, Continued Feeding	
		14. Unlocked Genitalia
Post-Copulatory Phase	15. Walked Away, Continued Feeding	
		16. Walked Away, Began Grooming

TABLE 1. Reaction chain illustrating sequence of events in the mating behavior of *Philonthus alumnus*. (see text for explanation)

Rubbing. Types of rubbing observed in ca. 10 different individuals of *P. alumnus* included antenna, eye, thoracic, foreleg, midleg, hindleg, and abdomen rubbing. The ultimate goal was to pass (via the forelegs) particulate matter to the mouthparts for ingestion. Dissection of the digestive tract after grooming clearly showed that detritus (in this case charcoal dust) was ingested.
1.) *Antenna Rub.* In *P. alumnus* this pattern was usually coupled with, and occurred as a continuation of, eye rubbing. The foretarsus was raised and brought forward such that its ventral surface contacted the dorsal side of the ipsilateral antenna. The tarsus was then scraped over the base of the antennae as the foreleg was extended. Afterwards, the leg was either returned to its normal position, or more often the tibia and tarsus were removed to the mouth for cleaning. Unlike many beetles (Valentine 1973), *P. alumnus* exhibited only unilateral antenna rubbing.
2.) *Eye Rub.* In *P. alumnus* this behavior involved raising the foreleg and making contact between its ventral surface and the posterior corner of the ipsilateral eye. The leg was then extended forward, scraping the eye with the tibia. This movement was often continued so that the eye and antennal base were groomed in one continuous motion. Afterwards, the leg was either returned to its original position or removed directly to the mouth for cleaning. Only unilateral eye rubbing was observed.
3.) *Thorax-Midleg Rub.* The dorsal surface of the thorax (pronotum and elytra) was groomed by unilaterally rubbing it with the mesotibia. Often, the first 2 abdominal tergites were groomed as a continuation of this pattern. Detritus was picked-up by the mesotibia and passed to the foreleg for ingestion (via the foreleg clean).
4.) *Foreleg-Foreleg Rub.* This rarely observed pattern involved balancing the body on the mid- and hindlegs while lifting and bringing the forelegs together under the head. Here the foretibiae were rapidly scraped one against the other such that detritus accumulated on 1 tibia only. The soiled tibia was then cleaned with the mouthparts.
5.) *Foreleg-Midleg Rub.* This grooming pattern, one of the most commonly observed in *P. alumnus*, allowed detritus removed from the thorax and abdomen to be passed to the mouth for ingestion. Success was accomplished by holding the midleg stationary (either in a raised or normal, depressed position) and rapidly rubbing all surfaces with the foretibia.
6.) *Midleg-Hindleg Rub.* Particulate matter removed from the abdomen by the hindleg was passed to the mouthparts via the mid-hindleg rub, fore-midleg rub, and foreleg clean. The hindleg remained relatively stationary, but was rotated in several directions so that all sides were rapidly scraped by the mesotibia.
7.) *Hindleg-Abdomen Rub.* Detritus was removed from all aspects of the abdomen by scraping it with the metatibia and metatarsus (both uni- and bilaterally). In unilateral rubbing, the abdomen was tilted toward the hindleg.

Effect of Amputation on Grooming Behavior. Because of the apparent importance of the mid- and forelegs in the grooming sequences of *P. alumnus*, 2 tests were conducted to see how grooming was accomplished in the absence of one of these appendages. Two beetles were lightly anesthesized with CO_2, and the midleg or foreleg was amputated from each specimen. After recovering from the anesthetic, these beetles were lightly sprinkled with chalk dust and their grooming success noted.
1.) *Midleg Amputee.* Both mid-foreleg and hind-midleg rubbing was attempted by this beetle. Afterwards, the foreleg was cleaned with the mouthparts as though it had removed detritus from the missing midleg. Due to the missing appendage the beetle was unable to remove detritus from the ipsilateral side of the pronotum and elytra. Attempts at the mid-hindleg rub were difficult to observe. (Even when the midleg was fully intact the hindleg moved very little. Therefore, the fact that the hindleg did not move in this test gave little indication of whether or not the beetle was attempting to groom the hindleg with the missing midleg.) However, when detritus was picked up by the hindleg, the beetle would eventually clean the ipsilateral foreleg indicating the beetle's attempt to complete the instinctive grooming sequence which passes detritus from hindleg to midleg to foreleg to mouth.

2.) *Foreleg Amputee.* This beetle made every attempt to use the missing foreleg in its normal manner. However, when this was not successful in removing detritus, alternate methods were employed. In lieu of the missing foreleg, the antenna was pulled into the mouthparts with the ipsilateral midleg, while detritus was removed from the midleg by cleaning it with the mouthparts or (on rarer occasions) rubbing it with the contralateral foreleg. This beetle was, however, unable to remove detritus from the ipsilateral eye.

Discussion

P. alumnus is a highly predaceous staphylinid. Indirect evidence for this evaluation is seen in many phases of its behavior: i) the attack-like pattern of the male during the preliminary phases of the mating sequence, (ii) the spacing-out of individuals in the observation chamber, and (iii) the apparent cannibalism in the absence of a food source. Direct evidence for this evaluation is seen in the beetle's willingness to accept a wide variety of small insects as food (Collembola, lepidopterous larvae, and *Drosophila* larvae, pupae, and adults).

The female's elusive behavior (during the preliminary phase of the mating sequence) is similar to that of other individuals when protecting their prey from competitors. Thus, the female may not be trying to elude the male's copulatory endeavors, but rather, she may be simply attempting to defend her prey.

Most grooming patterns in *P. alumnus* are unilateral and the ultimate goal is to pass detritus to the mouth. This feat is accomplished by relaying (from one appendage to the other, or through direct oral cleaning) particulate matter anteriorly to the mouth. Dissection of the digestive tract clearly shows that much of this detritus is indeed ingested.

P. alumnus apparently has several preadapted mechanisms allowing it to compensate for missing grooming structures. Since the beetle attempts to use missing appendages in their normal grooming sequence, it appears that much of this behavior is instinctive. However, the inability of *P. alumnus* to remove detritus from the eye (Foreleg Amputee) illustrates the extreme importance of the appendages in the overall grooming success of this beetle.

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FIRST NEW YORK RECORD FOR *CARABUS MAEANDER* FISCHER (COLEOPTERA, CARABIDAE)

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ABSTRACT

Carabus maeander was found in large numbers in Clinton County, New York. Of the 23 specimens collected, 2 females had full wings. This is a new state record.

Lindroth (1961) gave the range of *Carabus maeander* Fischer in the United States from Minnesota to Maine. Adult specimens are herein reported from New York for the first time.

Twenty-three specimens were collected in Clinton County in the Peru area. Many beetles appeared each night from April 17th. through April 20th. (1976) in a crushed stone driveway and on an adjacent lawn, both of which were illuminated by a street light. The collection dates coincided with the first few extremely hot days of spring, however, the beetle did not reappear on subsequent nights, following low temperatures and a snowfall. Seventeen of the 20 specimens collected were examined for wing condition, and one female had full wings.

C. maeander was taken in pitfall traps in July, 1976 at two semi-open (*Cornus* spp.) collecting sites, one fully winged female on Valcour Island, Lake Champlain and two males in Valcour, New York, directly opposite the island.

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A NEW SPECIES OF *ACMAEODERA* (COLEOPTERA:BUPRESTIDAE) FROM BAJA CALIFORNIA AND SOUTHERN CALIFORNIA

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Abstract

Acmaeodera bacchariphaga, new species, is described from northwestern Baja California, Mexico and San Diego County, California, and its biology, habitat, and variability are discussed. The relationship of this species to others in the genus is considered in detail, with particular reference to Fall's (1899) group "Lobatae" which is recharacterized.

Introduction

On a collecting expedition to northern Baja California, Mexico during June, 1970 D. S. Verity collected a single specimen of a species of *Acmaeodera* which he immediately recognized as new. Collecting in subsequent years has produced a substantial series from the same general area, as well as a few specimens from San Diego County, California. This species is described herein so that the name may be available for inclusion in the USDA Coleoptera Catalog and for a faunal study of the Buprestidae of Baja California.

In light of the great amount of buprestid collecting done in extreme southern California it is especially interesting that a new species of *Acmaeodera* should just recently have become known. Several large collections were searched for this species but apparently only those specimens listed herein exist. For this reason considerable space is devoted to describing the habitat. Knowing this and the host plant should enable students of the group to make further observations on this beetle.

The authors gratefully acknowledge W. F. Barr, University of Idaho, for bringing to our attention the significance of the humeral angles of the elytra in the genus *Acmaeodera* and for reviewing the manuscript. We thank B. K. Dozier, Chula Vista, California for providing additional specimens for study.

Acmaeodera bacchariphaga Westcott and Verity, **new species**

(Figs. 1-7)

Holotype Female: Medium-sized, moderately robust, slightly convex; head, pronotum and venter bronzy-black; pronotum with distinct purplish reflections; elytra black with faint purplish sheen, each elytron with a discal and marginal row of light-yellow markings as in Fig. 1.

Head rather coarsely, shallowly, reticulately punctate, rather densely clothed with a mixture of long erect whitish and brownish hairs; front flattened above, transversely convex at middle, flattened again anteriorly.

Pronotum twice as wide as long, considerably wider at base, distinctly narrower than elytra, strongly, evenly convex along sides, subflattened on disc, with narrow, very shallow median depression extending from apex to back of middle, and with distinct transverse depression behind front margin on either side of middle; front margin subtruncate along middle; hind margin feebly bisinuate; lateral margins entire, not visible from above, parallel for basal 2/3 then slightly deflexed to rather squarely rounded front angles; surface with moderately placed, shallow, medium punctures on disc, punctures much coarser and reticulate laterally; surface clothed with long, erect whitish hairs (especially at sides) which are strongly interspersed with brownish hairs on disc and slightly less densely placed than on head.

Elytra twice as long as wide, widest below umbones, width at base equal to base of pronotum; sides almost vertical; humeral angles strongly, triangularly produced anteroventrally; lateral margins when viewed from side strongly arcuate to just beyond umbones, then gradually, shallowly converging to apices, rather strongly serrate on apical 3/5, serrations more acute and pronounced towards apex; surface moderately clothed with long, erect coppery-brown hairs lightly interspersed with whitish hairs, particularly on apical 1/2; punctures of first stria fine and subequal to interstrial punctures, gradually becoming very coarse and deep from fifth stria outward; discal striae moderately impressed on apical 1/3; first through eighth interstrial spaces subflattened, ninth through eleventh moderately convex; interstrial punctures rather fine and shallow, slightly larger laterally; elytral punctures discrete basally; suture slightly depressed basally, flat along middle, moderately elevated from about apical 2/5.

Ventral surface clothed with long silky-white hairs, moderately on middle, quite dense at sides; front margin of prosternum strongly retracted, with well developed rounded prominence on either side of subtruncate and moderately deflexed middle; abdomen with medium-fine punctures moderately placed on middle, dense at sides, much larger anteriolaterally on first visible sternite; last visible sternite broadly, evenly rounded apically, with very well developed, deeply undercut, rather narrowly rounded subapical plate which almost attains hind margin.

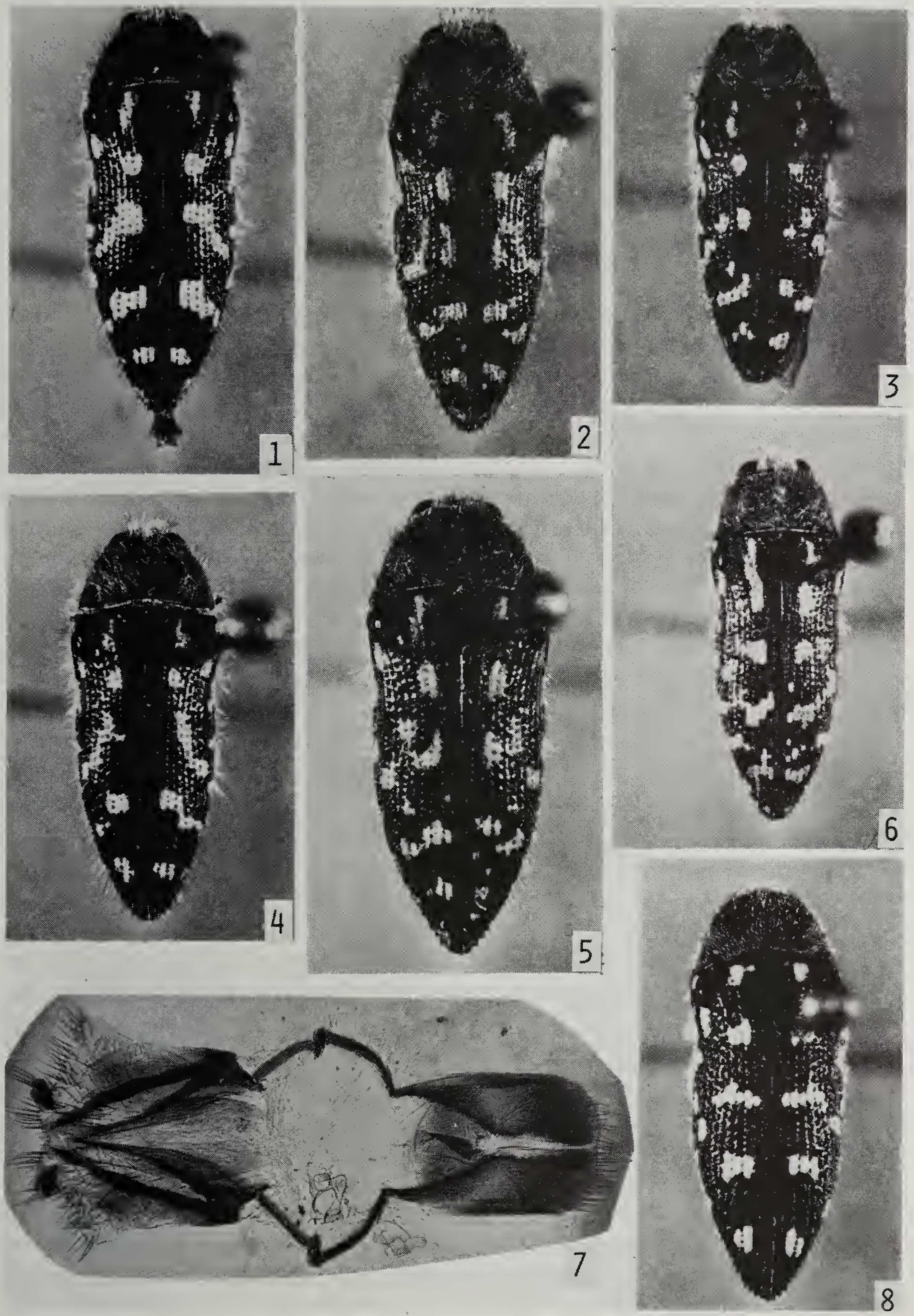
Genitalia as in Fig. 7.

Length: 9.1 mm. Width: 3.5 mm.

Holotype (California Academy of Sciences #12747) labeled: "MEX: Baja Calif. N., 16.7 mi SE Santo Tomas, 150 m, 5-VII-1975, R. L. Westcott, on flowers of *Bebbia juncea & Stephanomeria* sp., HOST PLANT: *Baccharis sarothroides*". Paratypes as follows: same data as holotype (13), collected by B. K. Dozier (9). 12.3 mi SE Santo Tomas, 245 m: 13-VI-70 & 27-V-73, D. S. Verity (2); 30-VI-73, Westcott & Fisher (15); 31-V-74, R. L. Westcott, J. M. Davidson, P. D. Christenson (4); (4-5)-VII-75, R. L. Westcott (4). 10.5 mi SE Santo Tomas, 290 m, 5-VII-75, R. L. Westcott (2). UNITED STATES, California, San Diego Co., Cottonwood Creek, Barrett, 305 m, 7-VII-75 (2) and 4.6 mi SE Dulzura, 410 m, 7-VII-75 (1), R. L. Westcott. Paratypes are deposited in the collections of the California Academy of Sciences, Los Angeles Co. Museum of Natural History, Universidad Nacional Autónoma de México, United States National Museum of Natural History, W. F. Barr, F. M. Beer, B. K. Dozier, G. H. Nelson, S. G. Wellso, and the authors.

VARIABILITY

For the most part, *A. bacchariphaga* is remarkably uniform in appearance. The most obvious individual differences are in elytral maculation (Figs. 1-6) and size (6.8-10 mm long). Twelve of 53 specimens examined have a small yellow spot on each side (1 side on 1 specimen) of the pronotum at about the basal 1/4-1/3. Examination under a microscope may be necessary to detect the spots on some specimens, while on others they are clearly visible to the naked eye. All specimens possess a humeral spot on each elytron. The front margin of the pronotum may be very feebly lobed along the middle. The elytra may be serrate only along the apical 2/5 rather than 3/5 as in the holotype. The apex of the subapical plate may attain the hind margin of the last visible sternite. The margin of this plate varies from broadly, evenly rounded throughout to a condition in which the apical portion is rather narrowly rounded. The latter condition applies to most males examined but in our opinion it is not sufficiently consistent to be a reliable sexual character. Westcott (1971) discussed a similar difference in *A. recticolloides* Westcott.



Figs. 1-7, *Acmaeodera bacchariphaga*, new species: Fig. 1, Holotype; Fig. 2, 12.3 mi SE Santo Tomas, Baja California; Figs. 3-6, type locality; Fig. 7, female genitalia. Fig. 8, *A. delumbis* Horn.

CLASSIFICATION

A. bacchariphaga is not closely related to any species known to us. Based largely on the structure of the humeral angles of the elytra and of the female genitalia it appears most related to *A. delumbis* Horn (Fig. 8), which belongs to the *gibbula* group of species. These have the humeral angles very strongly, triangularly produced anteroventrally. In *A. bacchariphaga* they are produced in a very similar manner but not so extensively. Several other species of *Acmaeodera* have these angles more or less produced, notably *A. rubronotata* Laporte and *A. miliaris* Horn. However, in those species the angles are produced much more ventrad and are not conspicuously triangular in outline. *A. bacchariphaga* is immediately separable from *A. delumbis* by its much longer vestiture, by not having elytral intervals 1, 3, and 5 elevated basally, and by its much smaller size.

Since Fall's (1899) key to North American species of *Acmaeodera* is hopelessly out-of-date in light of the numerous species described subsequently, it is pointless to correlate *A. bacchariphaga* therein, except to indicate that it will key to his group "Sinuatae". However, as we have pointed out, its apparent affinities lie with the *gibbula*-group which Fall (1899) called "Lobatae". He characterized this group as having the sides of the front margin of the prosternum attaining the front angles of the pronotum. We have examined numerous specimens of *A. gibbula* and *A. delumbis* and find this to be variable. If "Lobatae" is to be retained as a group, then it is much better characterized by the structure of the humeral angles of the elytra.

A. bacchariphaga bears marked superficial resemblance to the more robust, heavily marked forms of *A. mojavei* Westcott, from which it can be most readily distinguished by its bronzy-black pronotum and well developed subapical plate on the last abdominal sternite. An occasional specimen of *A. serena* Fall may resemble *A. bacchariphaga*, but the former belongs to an entirely unrelated group and can easily be distinguished by the purplish-blue (sometimes greenish) cast to the elytra and elongate yellow lateral maculation of the pronotum.

BIOLOGY AND HABITAT

Dead adults and portions thereof, larvae, and borings were found in branches of broom baccharis, *Baccharis sarothroides* Gray, at most of the localities mentioned. Most work was found in the lower branches of the plant, and larvae undoubtedly utilize the crown; however, an adult emergence hole was found 1.2 m high and larval borings were located at 1.5 m. Adults were collected from flowers of *Bebbia juncea* (Bentham) Greene and *Stephanomeria* sp. or were found resting on dead twigs, usually of *Hymenoclea monogyra* Torrey & Gray but occasionally on the host plant. A single adult was collected on the flower of *Cirsium* sp. in California (4.6 mi SE Dulzura), though it was observed to fly there from the vicinity of a *B. juncea* plant.

Larvae of what undoubtedly is *A. bacchariphaga* were collected from branches of *B. sarothroides* 9.3 miles west of Dulzura, San Diego Co., California, sharing this host with another buprestid, *Chrysobothris bacchari*

Van Dyke. Vegetatively, this area, at an elevation of 150 m, appears to be a transition between chaparral and coastal sage scrub. A few miles to the east, at an elevation of 410 m, the beetle was found in a disturbed area of the chaparral community. The habitat at Barrett is a mixture of open, dry flat and marginal riparian vegetation along Cottonwood Creek. Dominant plants are *B. sarothroides*, *Pluchea sericea* (Nuttall) Coville, and *Eriogonum fasciculatum* Bentham, with lesser numbers of *Artemisia tridentata* Nuttall, *Sambucus* sp., *Rhus* spp., and *Opuntia* sp.

Specimens of *A. bacchariphaga* from south of Santo Tomas, Baja California have been collected in a broad wash with an open shrub cover variably dominated by *H. monogyra, B. sarothroides, B. juncea, Adolphia californica* Watson, *Ephedra californica* Watson, *Eriogonum fasciculatum, Eriogonum elongatum* Bentham, *Haplopappus palmeri* Gray, and *Opuntia* sp. The vegetation at low elevations of northwestern Baja California consists of an interesting mixture of species, some ranging into this area from the deserts to the south or east, and some from California to the north; however, the area also has a large number of endemics. Shreve (1936) considered this vegetation to be a distinctive transition type from desert scrub to chaparral. Epling and Lewis (1947) modified this viewpoint somewhat when they noted that the coastal sage scrub plant association (a shrubby vegetation type which is more open and lower in stature than chaparral) ranges south from central California to El Rosario in Baja California and therefore includes much of the transitional zone of Shreve. Mooney and Harrison (1972), in studying an east-west transect 60 miles south of Santo Tomas, found that the transitional vegetation was present at 100 m, coastal sage scrub at 400 m, and chaparral at 800 m.

The vegetation of washes exhibits selection for species that can withstand frequent disturbance. Elements from various adjacent plant communities may frequently be found growing with species usually limited to these special conditions. Of the total of 40 species of shrubs or large perennials noted at 2 of the collecting sites in the wash south of Santo Tomas, 18 species (45%) have their main distribution to the north in California (though a few of these continue south up to 200 miles into the deserts), 9 species (23%) have their main distribution in the deserts to the east or south, while an additional 9 species (23%) are essentially endemic to northwestern Baja California. The remainder are either widespread in range or are not as yet identified. Some species in the endemic group, such as *A. californica*, extend into southwestern San Diego County as do some desert species, such as *B. sarothroides* which ranges from San Diego County and northern Baja California to New Mexico and Sinaloa. The latter's preadaptation to the disturbed soils of washes enables it to grow abundantly along roadsides throughout its range. This phenomenon provides additional potential for the dispersal of *A. bacchariphaga*; however, it appears that this beetle's range is largely restricted to the coastal sage scrub plant community.

Much remains to be studied on the buprestid fauna of northwestern Baja California. However, it is interesting that both of the known species of (essentially) endemic *Acmaeodera, A. bacchariphaga* and *A. recticolloides* (on *E. californica*), are associated with plants that have their major distributions in the deserts to the east, and that the closest relatives of both beetles occur from central Arizona eastward.

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Addendum

On May 6, 1977 numerous branches of *B. sarothroides* were examined by the senior author in Arroyo Catavincito, Baja California, and several were found to contain larvae apparently identical to those determined as *A. bacchariphaga* from localities mentioned herein. This extends the beetle's range into the Central Desert, approximately 240 km southeastward, and shows that its ecological amplitude is greater than originally surmised.

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NEW TAXONOMIC COMBINATIONS IN BRUCHIDAE (COLEOPTERA)

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In preparation for a planned catalog of the species of Bruchidae of the Western Hemisphere, reassignment of the following species names is necessary: To **Mimosestes** Bridwell—*Bruchus brevicornis* Sharp, 1885, p. 463; *Bruchus cinerifer* Fåhraeus, 1839, p. 21; *Bruchus dominicanus* Jekel, 1855, p. 12; *Bruchus immunis* Sharp, 1885, p. 474; *Bruchus incanus* Boheman, 1839, p. 107; *Bruchus longiventris* Sharp, 1885, p. 476; *Bruchus nubigens* Motschulsky, 1874, p. 237; *Bruchus obscuriceps* Sharp, 1885, p. 463; *Bruchus strigatus* Motschulsky, 1874, p. 237; *Bruchus viduatus* Sharp, 1885, p. 474. To **Merobruchus** Bridwell—*Bruchus limpidus* Sharp, 1885, p. 456; *Bruchus solitarius* Sharp, 1885, p. 456.

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TRIGONOSCUTOIDES TEXANUS (NEW GENUS, NEW SPECIES) FROM TEXAS SAND DUNES (TANYMECINAE: CURCULIONIDAE: COLEOPTERA)[1]

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ABSTRACT

Trigonoscutoides texanus, a new nocturnal weevil from northwest Texas collected mainly in the spring, is associated with shin oak (*Quercus* sp.). Adults are compared with *Trigonoscuta* and *Miloderoides.* The adult characters shared by *Trigonoscutoides* and *Trigonoscuta* are probably due to convergence, since the members of both genera burrow in sand. The new genus has numerous characters that distinguish it from *Trignoscuta,* indicating at most a distant relationship. The new genus and species are described, male and female genitalia are illustrated, and a habitus photograph is included.

While identifying weevils in the Ohio State University collection I found a single specimen of this interesting new genus and species, so when I moved to Texas in 1970 I went to the sand dune area near Monahans in Ward County to try to collect more and to look for host information. I collected long series at several localities by sifting sand under shin oak (*Quercus* sp.). Weevils were 3″ to 12″ below the surface, only in areas where the shin oak grew.

On a later trip specimens were taken at night, walking on the sand and feeding on the shin oak. The emergent vegetation of the oak is 1 to 3 feet tall, with extensive rhizomes and branches under the sand dunes. Apparently these nocturnal weevils are active as adults in the spring. Frequent trips to the same localities in the summer, fall, and winter were all unsuccessful, but spring collecting was successful for several years. However one specimen was collected in June and one in early July, by other collectors, so at least some individuals are active during the summer.

Larvae were not collected despite numerous attempts. It is probable that they feed on roots and may be very deep in the sand. The dense latticework of oak rhizomes and branches under the sand makes deep digging very difficult, and I did not wish to destroy large areas of oak.

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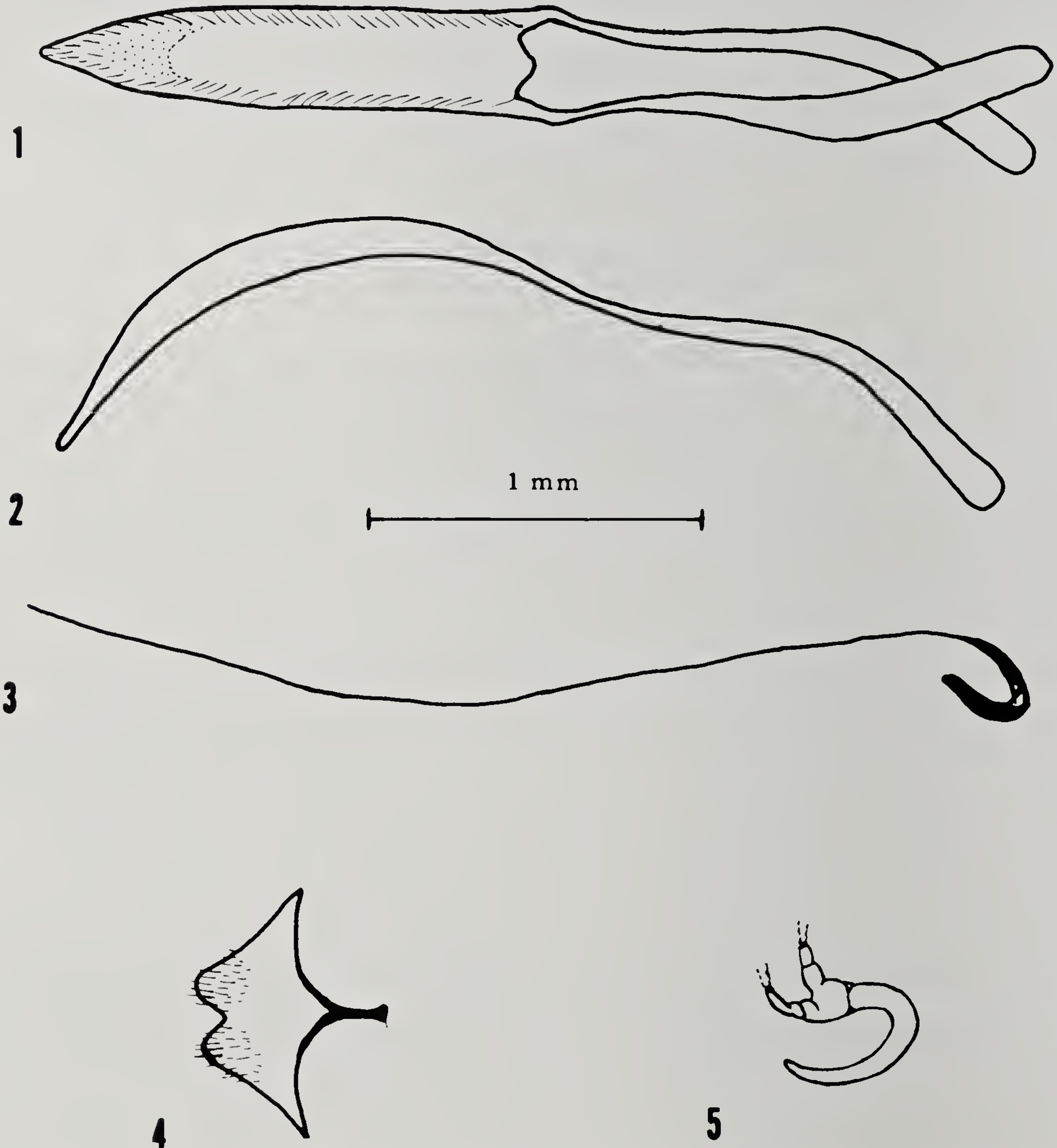
Trigonoscutoides O'Brien, **new genus**

Rostrum subquadrate, separated from frons by shallow but distinct transverse groove between anterior margin of eyes; nasal plate steeply angled to perpendicular, hind margin sharply carinate. *Antenna* short, scape scarcely reaching prothorax, with dense recumbent scales and erect setae. Funicle 7 segmented, basal segments with recumbent scales and erect setae, apical segments with scales replaced by coarse recumbent setae; club short, oval, densely pubescent. *Scutellum* large, broad and triangular. *Apterous*; humerus rounded; striae not visible.

Fore coxae contiguous, mid coxae narrowly separated, hind coxae, widely separated. Metepisternal suture not visible. Suture between abdominal segments 1 and 2 strongly arcuate at middle; segment much longer than 2, 2 longer than 3 and 4 combined, 3 and 4 subequal, 5 longer than 3 or 4. *Femora* strongly clavate, unarmed. Fore and mid tibiae uncinate, hind tibia produced in a long apical outer process, anterior margin somewhat acute, entire tibia flattened, rather bladelike. Corbel area of hind tibia open, strongly convex, clothed with dense recumbent scales and dense subacute strong subrecumbent to suberect spines. Third tarsal segment bilobed; claws free, simple.



Figs. 1-5, *Trigonoscutoides texanus*: 1) male, phallus, dorsal view; 2) male, phallus, lateral view; 3) male, flagellum, lateral view; 4) female, 8th sternite, dorsal view; 5) female, spermatheca, lateral view.

Type-species. *T. texanus* new species, by monotypy.

Several of the characters listed above will readily separate this genus from all other North American Tanymecinae. The strongly convex corbel area with the dense, coarse, subacute spines is unique in the subfamily. In *Trigonoscuta* the corbel is closed and concave, usually lacking spines. The corbel of *Miloderoides* is at most weakly convex with sparse, very short, blunt spines. The apical process of the fore tibia of *Trigonoscutoides* is acute and very elongate (ca. 2 to 3 times as long as broad), whereas in *Trigonoscuta* the process is usually blunt and seldom much longer than broad. *Miloderoides* lacks any process. The distinct sloping nasal plate with carinate posterior margin readily separates this new genus from *Trigonoscuta* and *Miloderoides,* both of which have a flattened, poorly defined nasal area, without a carinate margin. The adult characters imply a relationship with *Trigonoscuta,* but the morphological similarity is probably due mainly to convergence since both genera burrow in sand. The new genus has numerous characters that distinguish it from *Trigonoscuta,* and these indicate at most a distant relationship.

Trigonoscutoides texanus O'Brien, **new species**
(Fig. 1-6)

Type-locality. Texas, Winkler Co., 4.5 mi. N.E. Kermit [Hwy. 115].

Holotype male. Length of pronotum + elytron, 5.6mm. Black to reddish brown; body robust, elongate oval, convex, densely clothed with white, grey and brown recumbent irregularly shaped scales, and erect to suberect fine setae, finely subgranulate between scales.

Rostrum convex in basal 2/3 with weak median poorly defined depression, apical 1/3 concave to flattened, frons broad, flattened, convex, not imbricate, shining scales and dense, fine suberect setae; nasal plate and carina subglabrous, lacking scales, with sparse curved setae; lateral margin of rostrum at apex subdentate. Scrobe lateral, cavernous, visible in part from above, anterior margin sharply defined, posterior margin poorly defined, directed towards lower margin of eye; pterygia slightly projecting anteriorly. *Antennal scape* with dense, not imbricate, recumbent, shining scales, and long, fine erect setae; segments 1 through 5 with such scales and setae, 6 and 7 without scales, bearing only coarse recumbent setae and erect fine setae; segment 1 slightly longer than 2, 1 subequal to 3, 4 and 5; 6 and 7 gradually larger; club short, oval, subequal to segment 1. *Prothorax* transverse, sides strongly rounded, sharply constricted apically, weakly tubulate; anterior margin straight, with distinct postocular vibrissae; scales and setae as on head; posterior margin with elongate plumose scales (often rubbed or greased). *Elytra* widest behind humeri, gradually narrowing to broadly rounded apex; scales in part imbricate, arranged in alternate longitudinal, irregular lines of whitish and brownish; dorsal scales shining, normal; lateral margins in large part with plumose scales. *Venter* and coxae clothed mainly with plumose scales, setae longer than on dorsum. Metasternum and 1st abdominal segment broadly distinctly concave, 2nd segment flattened basally, weakly convex apically. *Legs* clothed with dense recumbent shining scales and very long fine erect setae; femur with imbricate scales; tibia with scales touching, not imbricate; tarsi dorsally with imbricate scales; ventrally 3rd tarsal segment of all legs with apical pubescent pad, smaller pads on segments 1 and 2 of fore tarsi only.

Allotype female. Length of pronotum + elytron, 6.7mm. Very similar to male, metasternum weakly convex, nearly flat at middle; 1st and 2nd abdominal segments convex.

Range. Known only from sand hills of Ward and Winkler Counties in northwest Texas.

Holotype male and allotype female. TEXAS, Winkler Co., 4.5 mi. N.E. Kermit, 20-IV-1970, L. and C. W. O'Brien, sifting sand under shin oak (deposited in the author's collection).

Paratypes. TEXAS: Ward Co., 1 mi. E. Monahans, 28-III-1970, L. and C. W. O'Brien * (13); 2 mi. E. Monahans, 28-III-1970, L. and C. W. O'Brien * (13); 4 mi. N.E. Monahans, 12-VI-1966, D. Larson and W. Sharp (1); Sand Hills, 8-VII-1968, W. E. and C. A. Triplehorn (1); Winkler Co., 4 mi. E. Kermit, Hwy. 115, 26-III-1972, C. W. O'Brien and G. B. Marshall * (33), beating shin oak at night (4), sweeping shin oak at night (6), sifting sand (15); 4.5 mi. N.E. Kermit, 20-IV-1970, L. and C. W. O'Brien * (111); 6 mi. S. Kermit, 20-IV-1970, L. and C. W. O'Brien * (1); 10 mi. N.E. Kermit, 20-IV-1970, L. and C. W. O'Brien * (7) (* = sifting sand under shin oak).

Paratypes are deposited in the following collections: British Museum (Natural History), London; author's collection, Tallahassee, FL; E. L. Sleeper, Long Beach, CA; Florida State Collection of Arthropods, Gainesville, FL; Anne Howden, Ottawa; Ohio State University, Columbus, OH; Texas A & M University, College Station, TX; Texas Tech University, Lubbock, TX; and National Museum of Natural History, Washington, D.C.

Specific variations and comparative notes. There were 202 specimens on hand for this study. They range in size from 3.9 to 7.0 mm. Although most of the specimens have the lineate color pattern of the type, I have a few specimens with a uniform grey or whitish scale color. Many of the specimens are greased, making the plumose scales very difficult to see. The scutellum is convex in some individuals and flat in others and in unrubbed specimens is densely clothed with plumose scales. Several of the specimens collected at the type locality on April 20, 1970 are teneral (soft and of pale tan color), indicating very recent emergence.

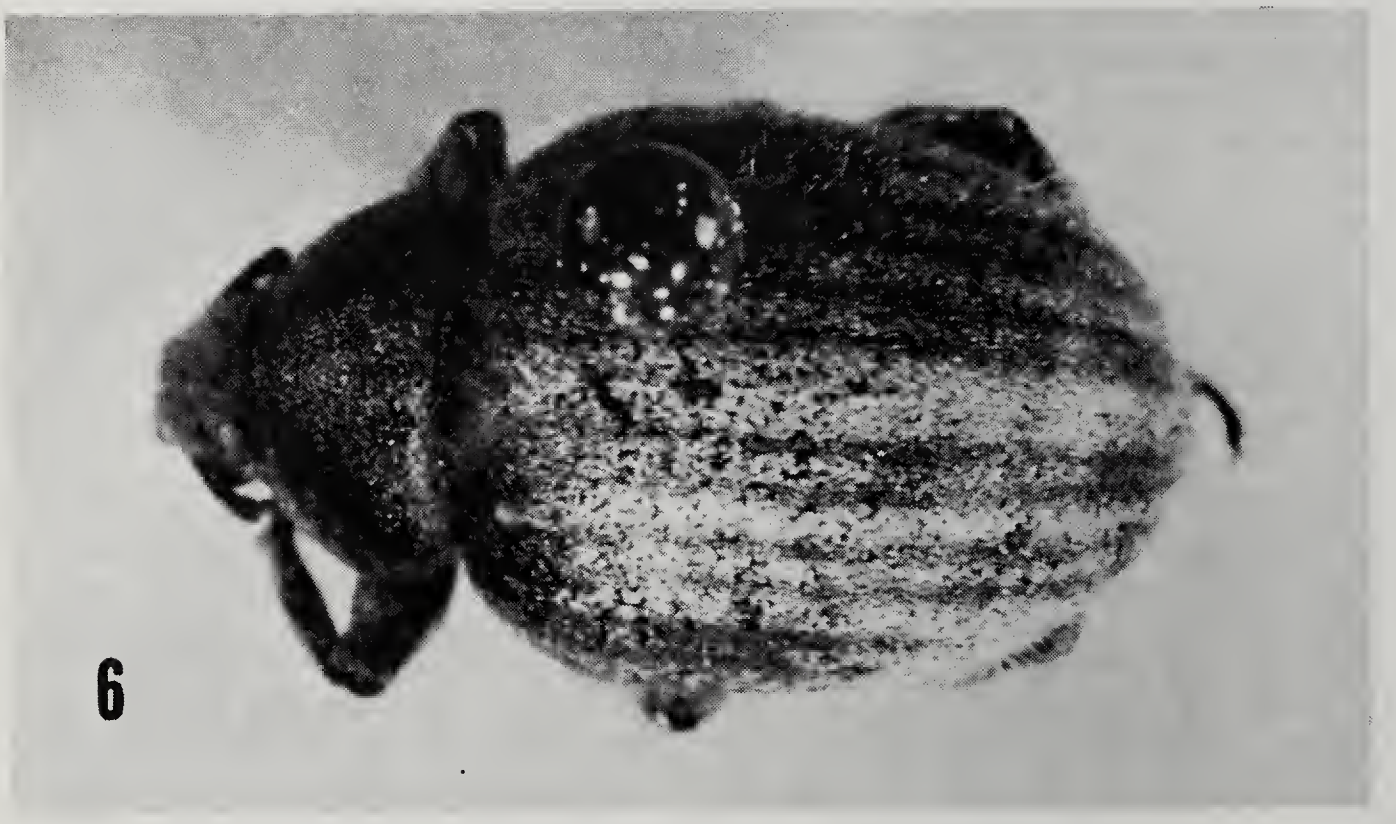


Fig. 6, *Trigonoscutoides texanus*: 6) dorsal view.

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A REDESCRIPTION OF THE LARVA OF *MORION CORDATUS* CHAUDOIR (COLEOPTERA: CARABIDAE, MORIONINI)

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Abstract

All three larval instars of *Morion cordatus* Chaudoir, the only species for which the larval form is known for the tribe Morionini, are described. Dorsal and ventral aspects of the third instar larvae and dorsal aspects of the head and terminal abdominal segments of the first instar larvae are illustrated.

Introduction

As result of a taxonomic synopsis of the tribe Morionini of the Western Hemisphere by Allen (1968), adults are relatively well known. However, larval stages of the tribe are poorly known.

Larval specimens of only one species from the Western Hemisphere (Costa Rica: Reventazon Riv., Hamburg Farm) have been described. These specimens were coassociated, under bark, with adults identified as *Morion georgiae* Palisot (Van Emden 1942, 1953), but *M. georgiae* is a synonym of *M. monilicornis* Latreille which is restricted to the United States and possibly Cuba (Allen 1968). Allen (1968) identified adults from this same locality (probably the same specimens) as *M. cordatus* Chaudoir. Therefore, the larval specimens should also be *M. cordatus*.

No keys are available for identification of the larvae of any genera of this small tribe of worldwide distribution. In fact, larval characters for the tribe were unknown until Van Emden (1953) realized he had incorrectly identified the *Morion* larvae from Costa Rica as *Scarites* "subg. *Distichus*?", included with the tribe Scaritini in his key to the genera of larval Carabidae (Van Emden 1942). The characters enumerated by Van Emden (1942, 1953) are sufficient to characterize the larvae of the tribe and probably of the genus *Morion* but probably not of the species *M. cordatus*.

After an extensive literature search only one illustration of a *Morion* larva has been found. Gressitt (1953) included a figure of *Morion ?orientalis* Dejean and a brief statement of its food intake while held in the laboratory. The figure was a lateral view and very little could be ascertained from it. No taxonomic description was included. Van Emden (1953), however, made a short character comparison of Gressitt's *Morion* larva with the *Morion* larva from Costa Rica and commented on the differences.

Due to the lack of illustrations and incompleteness of descriptions, I felt the larvae of *M. cordatus* should be described in more detail and illustrated. In preparation for this redescription, larval material from Panama, Mexico, and Brazil was examined. Except for the Brazilian specimen, each of the larval collections had coassociated adult *M. cordatus* collected in the same habitats or in the immediate vicinity, or *M. cordatus* was the only species of *Morion* encountered in the area (pers. comm. with collectors: R. T. Allen, T. L. Erwin, and G. E. Ball).

Numerous attempts to locate the larva described by Van Emden (1942, 1953) have been unsuccessful. It is my understanding from personal communications with Dr. H. F. Van Emden (son of the late Dr. F. I. Van Emden) that much of his father's larval carabid collection was on loan at the time of his death and that with no written records he was unable to trace it.

Larval Stages of *Morion cordatus* Chaudoir

Forty larval specimens were examined: 5 first instars, 12 second instars, and 23 third instars. Head capsule length measurements were made from anterior edge of mid nasale to posterior junction of ecdysial cleavage line; widths were measured across the widest areas of the head (slightly anterior to cervical grooves). Total length measurements were made on each larva when possible, from mandible tips to apices of urogomphi. Length measurements were not taken of specimens with broken urogomphi or of curled specimens hardened in that position by the preservative.

Measurements and illustrations were made with the aid of a Wild Heerbrugg, M-5 stereomicroscope, an ocular micrometer, and a V-1.25X camera lucida attachment.

Larval descriptions have traditionally been made from later instar specimens because minute characters are easier to observe and setal patterns are more stable. Also, later instar specimens are generally the larvae which are most often encountered in the field, and they usually comprise the bulk of collections. For these reasons it seemed logical to place most emphasis on the third instar larva and develop the most detailed descriptional account from this stadium. Therefore, I give the third instar larval description first.

Third instar larva, Figs. 1-12

Total length: 19 larvae; 20.91 mm (14.0 mm-25.0 mm). Head capsule: 22 specimens; length, 1.99 mm (1.66 mm-2.28 mm); width, 2.52 mm (2.25 mm-2.84).

Head capsule, mandibles, and antennae reddish-brown to piceous; prothorax and legs brownish-yellow; mesothorax, metathorax, urogomphi, and pygopod ochraceous; sternites and tergites usually ochroleucus, sometimes brownish-yellow; abdominal cuticle creamy white.

Head: Large, rectangular, depressed, prognathus. Nasale concave, smooth, slightly produced laterally; adnasale slightly produced, projecting beyond nasale (Fig. 1). Fronto-clypeal plate gently sloping from anterior end of ecdysial cleavage line to nasale; shape and setation as in Fig. 1. Mandibles narrow, subcylindrical; retinaculum in basal half reduced, blunt; penicillus absent; lateral margin with seta opposite retinaculum and 2-3 micro-setae at lateral base (Figs. 1-4). Antennae 4-segmented with 3rd and 4th articles bearing setae; node of 3rd article absent (Fig. 4). Maxillae well developed; cardo with seta; stipes cylindrical, long, divided above basal half, with 4-segmented palpus, 2-segmented outer lobe, and small inner node (Figs. 1, 2, 5). Labium with 2-segmented palpus; ligula absent (Figs. 1, 2, 5). Eyes, 2 stemmata each (Fig. 3).

Thorax: Prothorax slightly wider and slightly shorter than head capsule; mesothorax narrower and shorter than prothorax, metathorax narrower and shorter than mesothorax.

Legs: Short, robust, each with 2 claws of unequal length, the anterior slightly longer, thicker at base (Figs. 6, 7). Thoracic spiracle large, ovoid, twice size of spiracle on first abdominal segment.

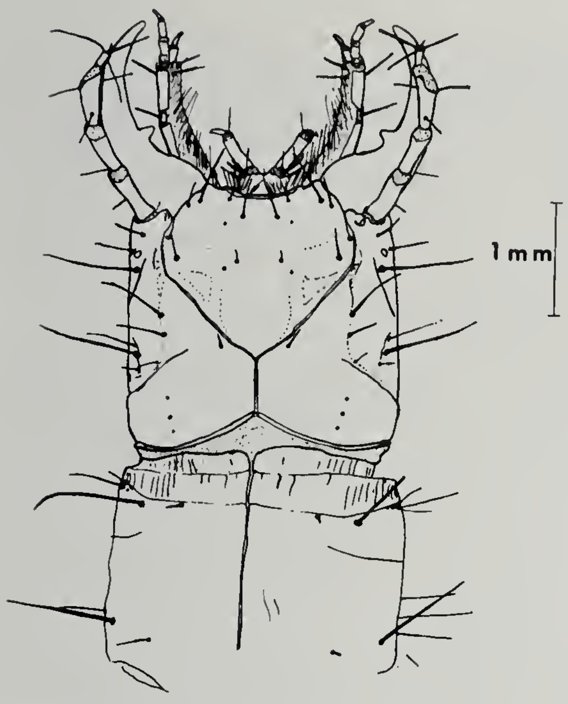
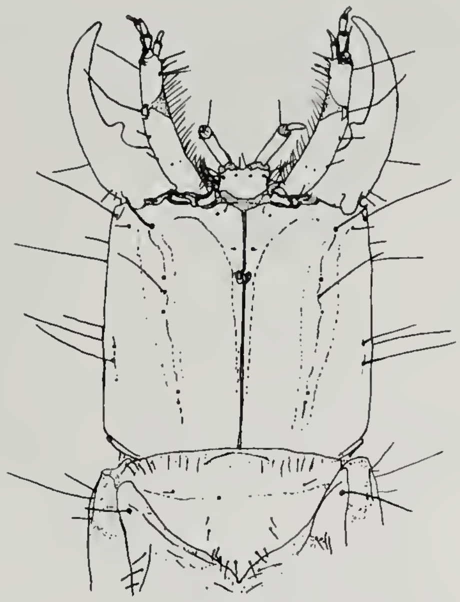


Fig. 1.



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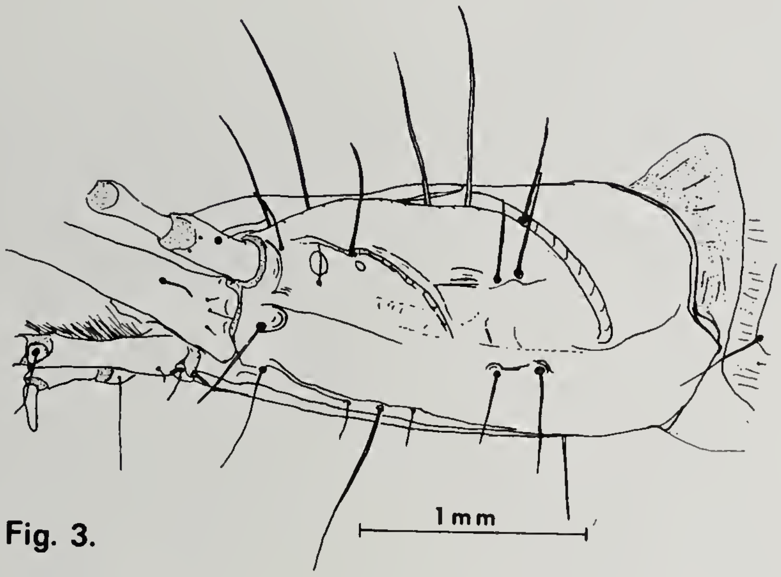
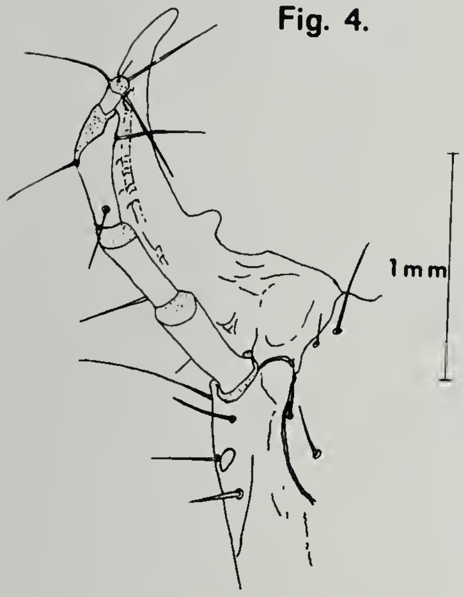


Fig. 3.

Fig. 4.



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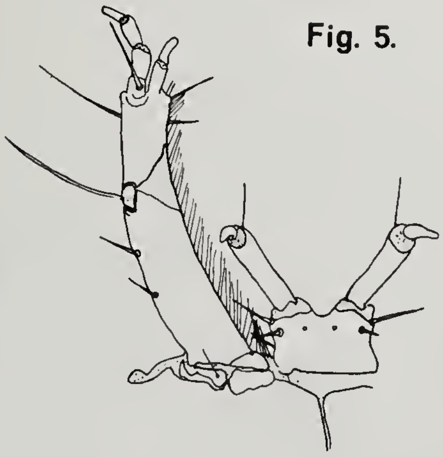


Figs. 1-5, *Morion cordatus* Chaudoir, Madden Forest, Panama, Canal Zone, third larval instar: 1) head capsule, dorsal aspect (light stippling indicates membranous area); 2) head capsule, ventral aspect; 3) head capsule, lateral aspect; 4) antenna and mandible; 5) maxilla and labium, ventral aspect.

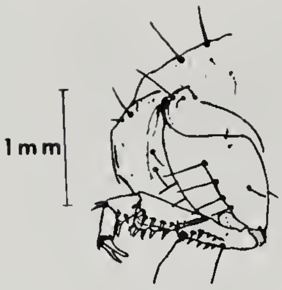
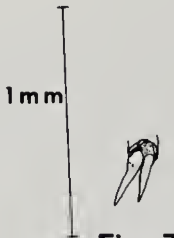


Fig. 6.



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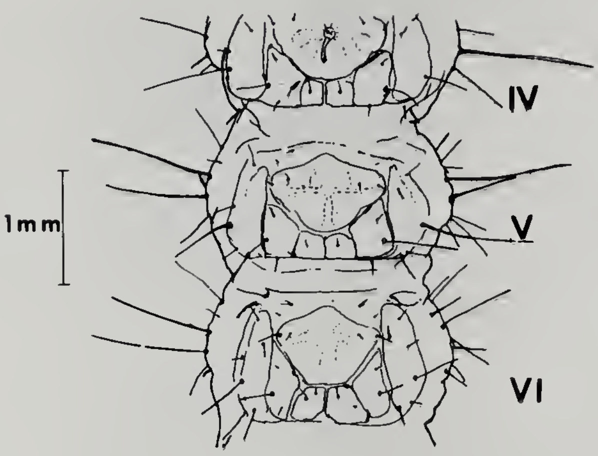

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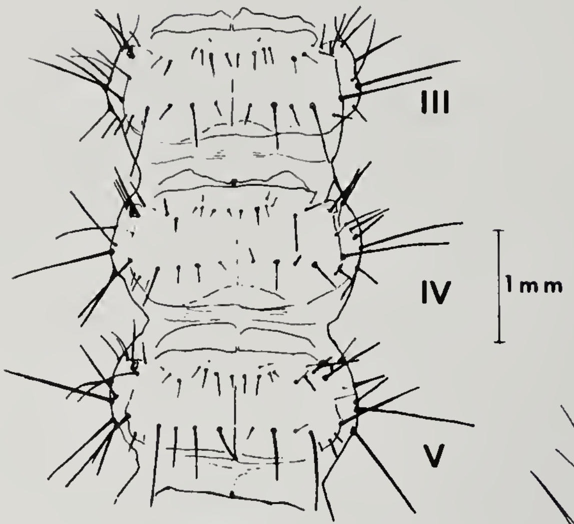

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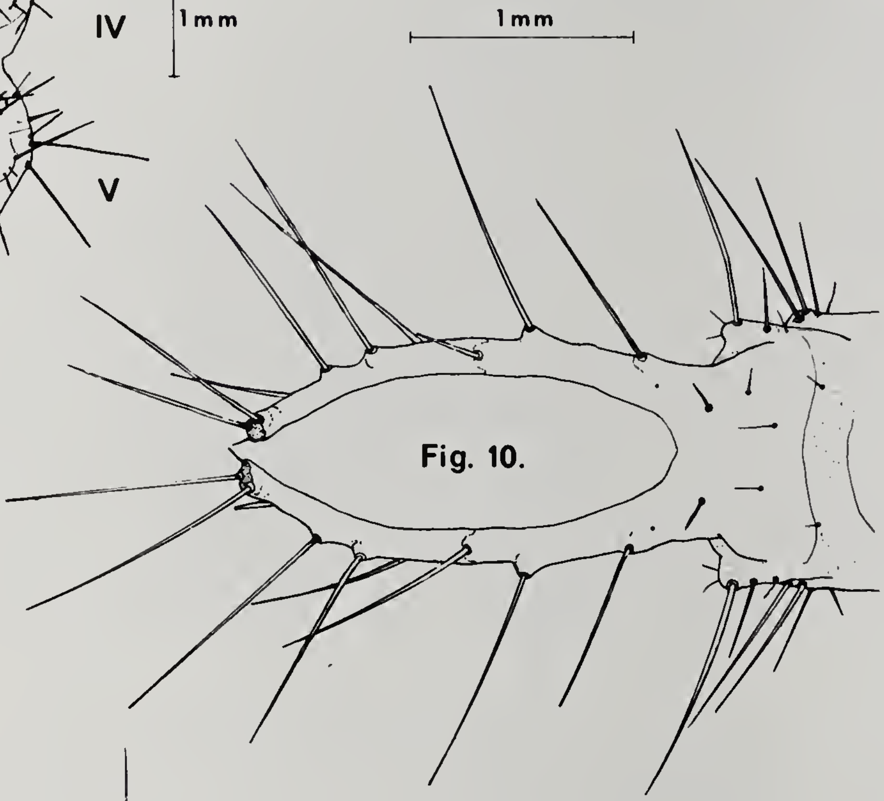


Fig. 10.

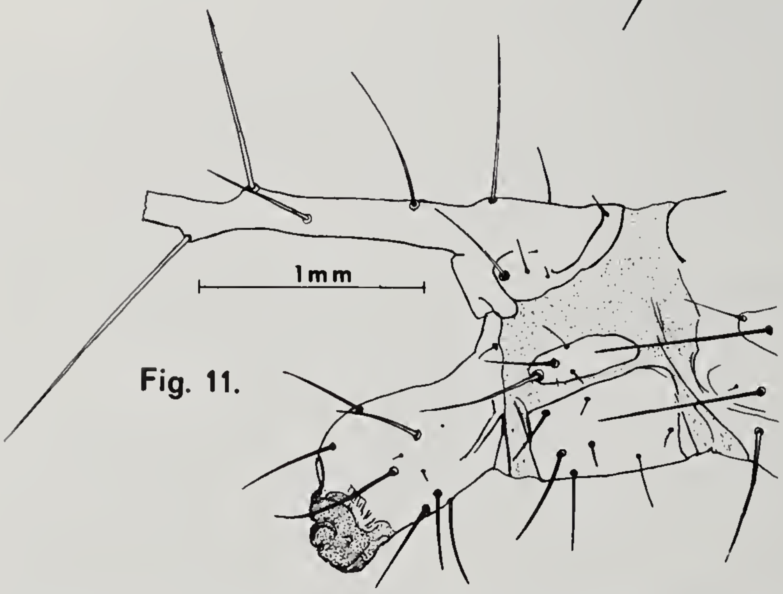


Fig. 11.

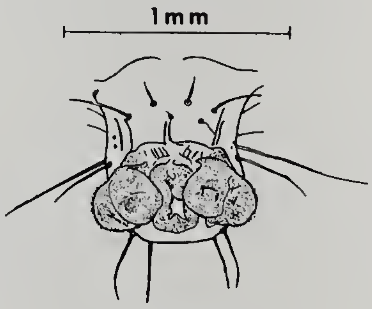


Fig. 12.

Figs. 6-12, *Morion cordatus* Chaudoir, Madden Forest, Panama, Canal zone, third larval instar: 6) metathoracic leg; 7) tarsal claws of metathoracic leg; 8) sternites, definition unclear due to reduced pigmentation; 9) tergites, definition unclear due to reduced pigmentation; 10) urogomphi, dorsal aspect; 11) segments IX and X; 12) bifid anal lobes, extended.

Abdomen: 10-segmented, sternites and tergites generally incompletely sclerotized (Figs. 8, 9). Urogomphi fused to segment IX, unjointed, nodose, each node unisetose, apex with 2 setae and a micro seta; 9 prominent setae on each urogomphus (Fig. 10). Pygopod well developed, with 2 bifid anal lobes apically, each completely covered with microcrochets (Figs. 11, 12).

Second instar larva

Total length: 10 larvae; 13.1 mm (11.0 mm-17.0 mm). Head capsule: 11 larvae; length, 1.33 mm (1.19 mm-1.44 mm); width, 1.69 mm (1.56 mm-1.84 mm).

There is a noticeable overlap of total lengths between second and third instar larvae, but lengths are highly variable and depend on age from last molt and food consumed. Therefore, total length is not a reliable criterion for determination of the various instars but is reported here as a matter of reference.

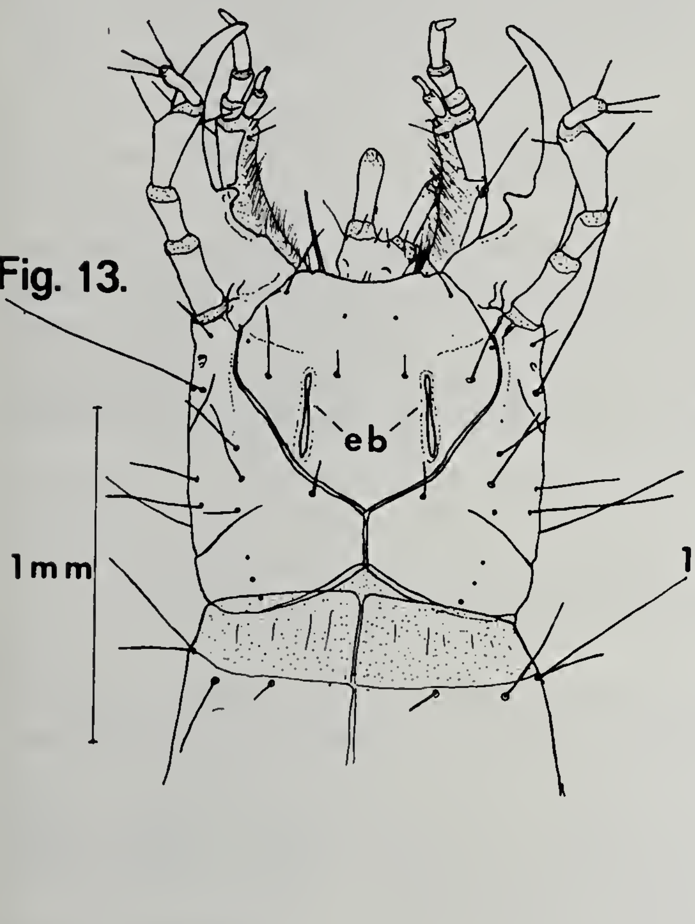
The second instars are similar to the third in pigmentation and general anatomical features with exception of head capsule dimensions. The average head width of the second instars was 1.6 greater than the average head width of the first instars and the average head width of the third instars was 1.5 greater than the second instars.

First instar larva, Figs. 13-14

Total length: 5 larvae, 8.1 mm (7.0 mm-9.0 mm). Head capsule: 5 larvae; length, 0.85 mm (0.81 mm-0.88 mm); width, 1.07 mm (1.03 mm-1.16 mm).

First stadium larvae are easily distinguished from second and third stadia larvae by the reduced pigmentation, presence of egg-bursters on the fronto-clypeal plate (Fig. 13), and presence on each urogomphus of only 5 prominent setae (Fig. 14).

Fig. 13.



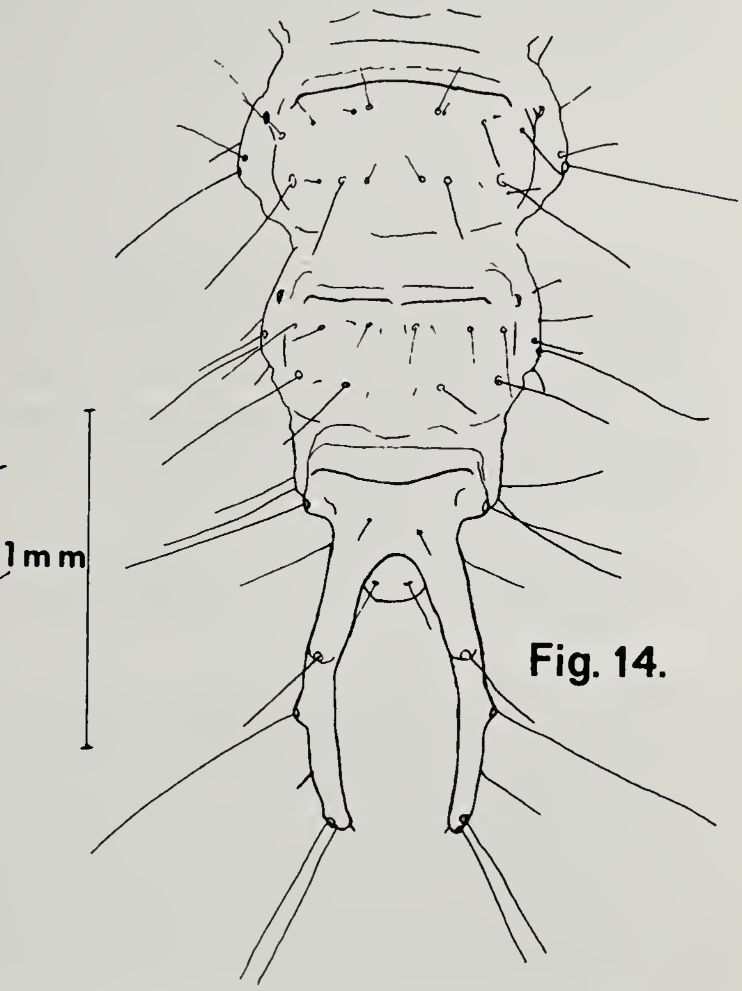


Fig. 14.

Figs. 13-14, *Morion cordatus* Chaudoir, Veracruz, Mexico, first larval instar: 13) head capsule, dorsal aspect (eb, egg bursters); 14) urogomphi.

Discussion

Van Emden (1942) stated that the growth factor for larvae is practically equal from the first instar to the second and from the second to the third. Comparisons of the various larval stages of *M. cordatus* substantiate his findings. The average head width of third instar larvae was 1.5 greater than that of second instars, and that of second instars 1.6 greater than that of first instars.

The phylogenetic position of this tribe is uncertain. Adults and larvae have definite structural affinities with both Pterostichini and Scaritini, two widely separated tribes. The problem of phylogenetic position will be considered in a future paper.

Locality Records

BRAZIL. Amazonas: Igarape, Belem near Rio Solimoes, 70 Km. E. of Leticia, 18-28 V 1970, B. Malkin, under bark, [FMNH] (1).

MEXICO. Chiapas: 4.9 mi. N. of Frontera—Comalapa, 2 IX 67, G. E. Ball, T. L. Erwin and R. E. Leech, under bark, 2400 ft., [UASM] (3); 11.4 mi. S. of Solosuchiapa, Route 195, 25 IV 66, G. E. Ball and D. R. Whitehead, under bark of tree down ca. 1 yr., 2100 ft., [UASM] (2); 16.3 mi. S.W. of Los Cruces, 29 VIII 67, G. E. Ball, T. L. Erwin, and R. E. Leech, under bark, 2820 ft., [UASM] (1). *Jalisco:* near Ixtapec, gallery forest, 22 XII 70, G. E. Ball and K. E. Ball, under bark of standing dead tree, 50 ft., [UASM] (2). *Veracruz:* 2.5 mi. W. of Sontecomapan, 21 VIII 67, G. E. Ball, T. L. Erwin, and R. E. Leech, under bark of log ca. 1 yr. old., 100 ft. [UASM] (20).

PANAMA. Canal Zone: Madden Forest, Los Cruces Trail, 2-VI-72, R. T. Allen, under bark of rotten tree [UAIC] (3); Barro Colorado Is. near Fairchild 6, 79° 56′ W-9° 12′ N, 28-II-75, 04-042 T. L. Erwin and J. L. Lawrence, under bark, [USNM] (4) (ADP43122, ADP43134, ADP43136, ADP43120); Barro Colorado Is. Zetek Trail, trail post #23, 9° 10′ N-79° 50′ W, 2-VII-74, T. L. Erwin and D. R. Whitehead, under loose bark of log, Expedition #55 in notebook #3, [USNM] (3) (ADP43118, ADP25623, ADP43117); Madden Forest, 1.5 Mi. N. Continental Divide, 79° 36′ W-9° 5′ N, 23-II-75, 04-029 T. L. Erwin and J. F. Lawrence, in bark, [USNM] (1) ADP43135.

Acknowledgements

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NEW *APION (COELOCEPHALAPION)* SPECIES (CURCULIONIDAE: APIONINAE) FROM FRUITS OF *PTEROCARPUS* (LEGUMINOSAE: FABOIDEAE) IN CENTRAL AMERICA

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Abstract

Apion pterocarpi (Bagaces, Guanacaste Prov., Costa Rica; fruits of *Pterocarpus rohrii* Vahl), *A. pepperi* (Mexico, indefinite locality; fruits of *P. orbicularis* DC), and *A. cartwrighti* (Turrialba, Cartago Prov., Costa Rica; host plant not known) are described as new, classified, keyed, and illustrated. These 3 species form a compact unit most closely related to *A. latipes* Sharp, in the *annulatum* group of the subgenus *Coelocephalapion.*

As Kissinger (1968) found, insufficient data are available for working up a complete revision of the North and Central American Apioninae. Many forms were left undescribed because they were represented by few specimens, often only of the difficult-to-interpret females, and obviously many tropical species were completely unrepresented; I suspect that about 90% of the Central American *Apion* fauna remains unknown. Moreover, natural history data are lacking for most of the known tropical forms. In view of the tremendous diversity in this and some of the other weevil groups in the New World tropics, therefore, I propose to deal in piecemeal fashion with species associated with particular groups of plants. This paper is the first in a projected series to focus on certain tropical American *Apion* species that are either under ecological study or of known or suspected agricultural importance.

In Costa Rica, *Pterocarpus rohrii* Vahl (=*P. hayesii* Hemsl.) is a tropical deciduous tree characterized by synchronized fruiting in 2 or 3 year cycles, and it therefore has been selected for close, long-term ecological observation by my friend D. H. Janzen (University of Pennsylvania). His fine series of *Apion* from fruits of this tree formed both the impetus and the core for this study. Descriptions roughly follow Kissinger's (1968) format, terminology, and technology. Illustrations were prepared by I. C. Feller, supported by Janzen's NSF Grant BMS 75-14268. I am indebted to R. W. Hodges, D. H. Janzen, and G. C. Steyskal for comment and criticism.

In the New World, *Pterocarpus* has not previously been recorded as a host genus for *Apion.* The 3 *Apion* species treated herein form a compact group readily recognized by large body size, somber coloration, strongly compressed body form, and technical characteristics. They belong to the *annulatum* species group of the subgenus *Coelocephalapion.* Two are known to attack fruits of *Pterocarpus,* and I predict from morphological characteristics that the third does also. The 2 *Pterocarpus* species mentioned in this paper are of negligible commercial value, but the genus does include several other species of value as timber.

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In Kissinger's (1968, p. 208) key to males of North and Central American *Coelocephalapion*, these 3 species trace readily to couplet 7 where they agree with *A. latipes* Sharp in having tarsus 3 unmodified; but the elytra are not bluish, and the femora are not bicolored. Although they agree also in compressed body form with *A. latipes,* which among described species is probably their nearest relative, they differ sufficiently in genital characteristics that I suspect the relationship is not close. Adults of *A. latipes* and the 3 new species are distinguished in the following key.

1. Elytra bluish; femur part red, part black .... *A. latipes* Sharp.
1′. Elytra piceous or dark castaneous, not bluish; femur uniformly piceous or dark castaneous or ferruginous 2

2(1′). Pronotal punctations dense, interspaces on average much less than half diameters of each, scales fine but conspicuous under high magnification 3
2′. Pronotal punctations less dense, interspaces on average about half diameters of each, scales minute and inconspicuous even under high magnification; Costa Rica .... *A. cartwrighti* Whitehead, new species.

3(2). Vestiture fine, inconspicuous at low magnification; length of body less than 3.5 mm; Costa Rica .... *A. pterocarpi* Whitehead, new species.
3′. Vestiture coarser, conspicuous at low magnification; length of body more than 3.5 mm; central Mexico .... *A. pepperi* Whitehead, new species.

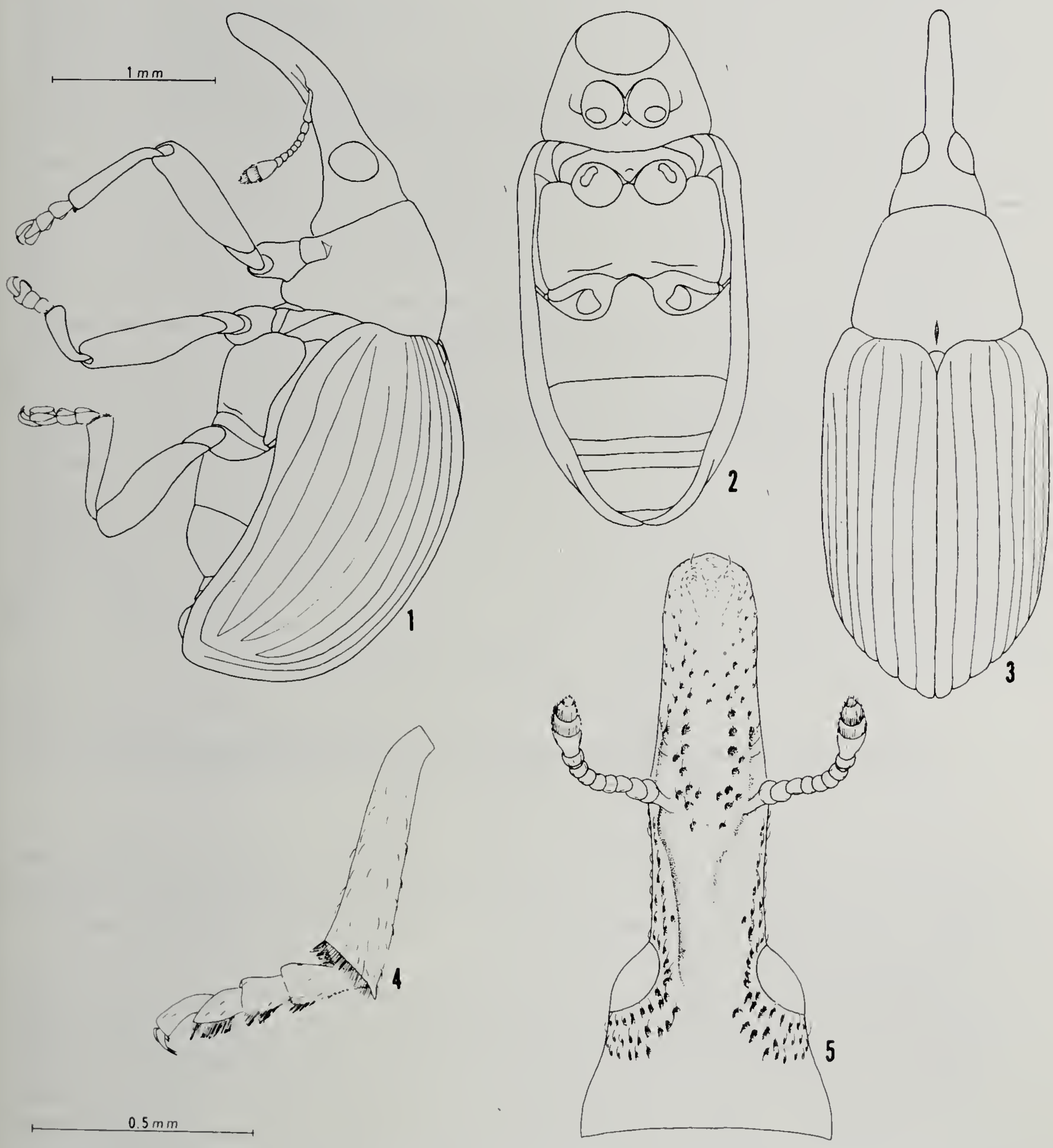
As is implicit in this key, adults of the 3 new species are remarkably similar in external characteristics; but in male genital characteristics, especially in detailed structure of the paramere (figs. 17, 20, 23), they are highly distinctive. Thus, despite lack of evidence about sympatry, they unquestionably represent distinct biological species. Since there are at least 5 widespread species of *Pterocarpus* in Mexico and Central America and several others in South America, I predict that this group of *Apion* is much more diverse than presently known and that its species are much more widely distributed than suggested by known records. I therefore think it premature to present a detailed hypothesis of phylogenetic relationships at this time.

Apion (Coelocephalapion) pterocarpi Whitehead, **new species**

Figs. 1-7, 11-12, 16-18

Type-material. Holotype male (USNM #75312), allotype female, and 18 paratypes labelled "COSTA RICA Guanacaste Prov. D. H. Janzen et al/Bagaces (COMELCO) 9 Mar. 1973/ex fruit Pterocarpus rohrii Vahl"; 4 paratypes, same locality and host, 19 March 1971, D. J. Janzen #595; 66 paratypes, same locality and host, 26 March 1971. In U.S. National Museum of Natural History; some paratype specimens will be distributed to various museums.

Comments. A. pterocarpi is known only from the type-locality, reared from fruits of *Pterocarpus rohrii* Vahl (= *P. hayesii* Hemsl.). At Santa Rosa National Park, about 60 km north of the COMELCO ranch, D. H. Janzen (pers. comm.) found another population of *Pterocarpus rohrii.* There, however, the fruits were heavily infested with an undescribed species of *Amblycerus* (Bruchidae; J. M. Kingsolver, pers. comm.) rather than the *Apion.* Although the 2 populations of *Pterocarpus* are currently regarded as conspecific, fruits of the Santa Rosa population are about twice as large as those of the Bagaces population. The significance of these observations, with respect to beetle distributions and also to taxonomic status of host populations, remains to be worked out. Also, Janzen states that a second *Pterocarpus* species has been reported from the Guanacaste lowlands, but he has not yet found a population of it.



Figs. 1-5, *Apion pterocarpi*: 1-3, lateral, ventral, and dorsal habitus outlines; 4, posterior aspect of left midleg; 5, ventral view of head.

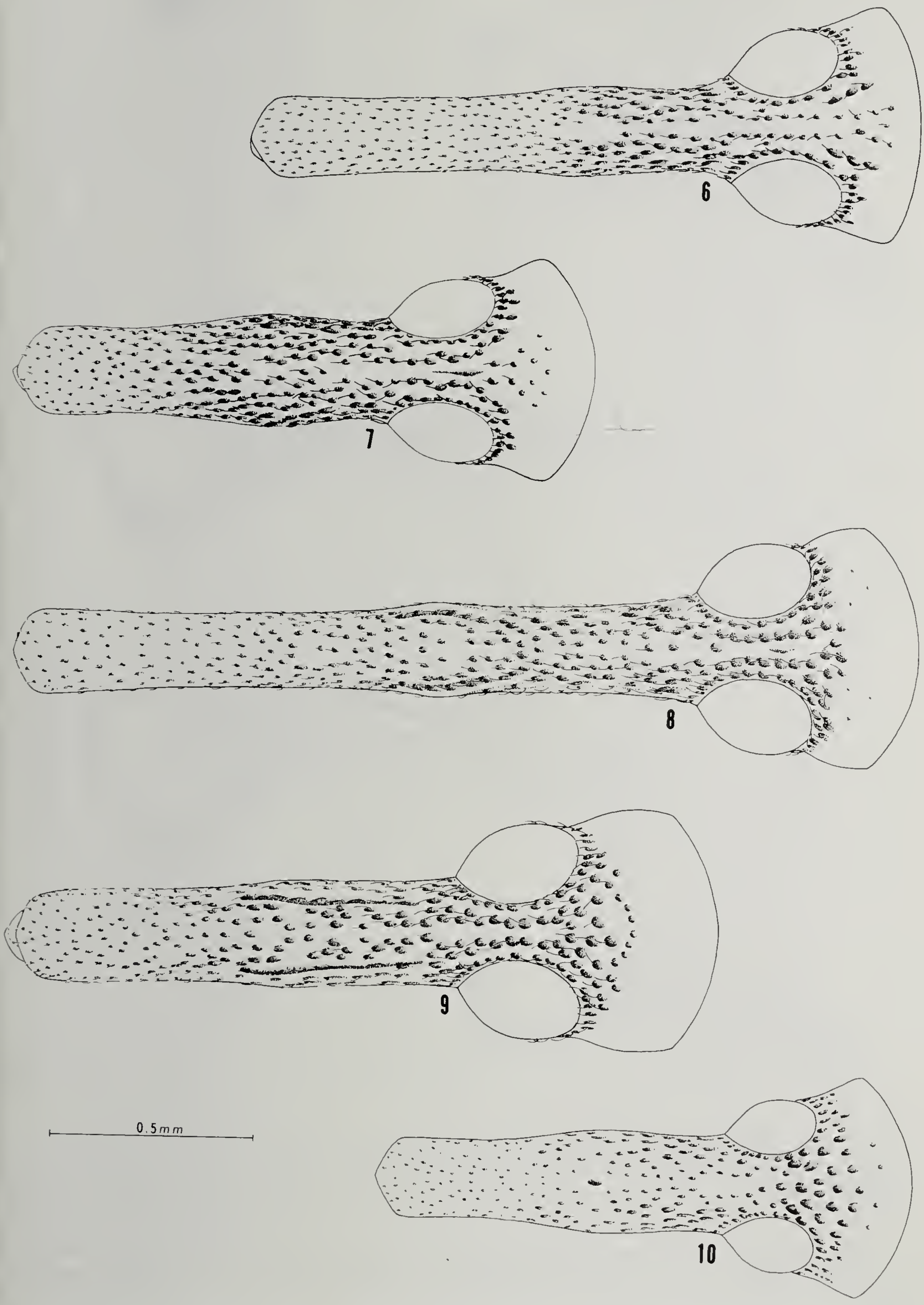
Description. Length 2.99-3.29 mm; width 1.20-1.29 mm. Body (figs. 1-3) moderately robust, elytra compressed; dark castaneous to piceous, unicolorous; vestiture white, fine, sparse, nearly uniform. Male beak (figs. 7, 12) 1.11-1.14 × longer than prothorax; in side view moderately curved, dorsal and ventral outlines slightly convergent in apical 1/3, apex depressed; in dorsal view sides strongly expanded at antennal insertion, nearly parallel in apical 1/3; surface finely alutaceous in basal 2/3, conspicuously so in apical 1/3, dorsum with small, paired, polished calluses above antennal insertions; punctures coarse, deep, dense in basal 2/3, finer and sparser toward apex, with fine vestiture throughout but scales much shorter toward apex. Female beak (figs. 6, 11) 1.48-1.63 × longer than prothorax; similar to beak of male except more slender, punctures finer and sparser, and basal vestiture sparser. Antenna inserted at basal 0.30-0.36 of beak, at distance in front of eye 2.1-2.6 (male) or 2.9-3.0 (female) × greater than width of frons; dorsal margin of scrobe irregularly angulate at antennal insertion, beyond this point slightly oblique for short distance. In dorsal view, eye slightly prominent; frons 0.65-0.76 × as wide as apex of beak, with 2 rows of coarse punctures separated by strong median and lateral carinae; in profile, dorsal margin of head moderately convex above eye, declivitous to point behind posterior margin of eye; ventral surface of head (fig. 5) with moderately high, broad lateral ridges extending to middle of eye. Prothorax at base 1.08-1.14 × wider than long, middle distinctly narrower than base, apex 0.60-0.66 × as wide as base; in dorsal view sides evenly converging from base to unconstricted apex, without basal flange; dorsal margin slightly convex, more strongly so in posterior 1/2, somewhat flattened in apical 1/2; on dorsal surface punctures 0.04-0.05 mm in diameter, moderately shallow, bearing fine scales mostly 0.03-0.04 mm long, scales project beyond anterior rims of punctures, interspaces much narrower than diameter of punctures, coarsely alutaceous; basal fovea 0.05-0.08 mm in diameter, not conspicuously elongated. Scutellum elongate, widest at base, flat or feebly impressed medially, set in weakly defined, basal, cordate elytral impression. Elytra at humeri 1.32-1.39 × wider than prothorax at base, 2.70-2.80 × longer than prothorax, 1.85-1.92 × longer than wide; intervals at middle about 3 times as wide as striae, nearly flat, with 2 partly confused rows of minute punctures bearing minute scales shorter than those on prothorax, intervals 7 and 9 each with 1 long specialized seta; striae moderately shallow, moderately coarse, inner portion of stria more strongly developed than lateral portion, on apex join 2 + 9 (or 1 + 2 + 9); 3 + 4; 5 + 6; 7 + 8; without pit on elytral apex at union of striae 1 and 9. Male characters: tibiae 2 and 3 mucronate, mucrones acute, triangular, barely projecting beyond apical fringe of setae (fig. 4). Phallus (figs. 16, 18) in side view moderately convex, apex very slightly produced ventrally; in dorsal view sides nearly parallel from base to orifice, beyond orifice converging to narrow apex; internal sac without conspicuous armature; posterior apophyses approximately 0.40-0.45 × as long as rest of median lobe. Paramere (fig. 17) moderately long, moderately slender; apical lobes short, broad, microtrichiae numerous, without conspicuous large setae; without distinct transverse clear areas; with short, slender basal lateral projections articulating with basal piece; basal median area with low ridge, with short basal median projection.

Apion (Coelocephalapion) pepperi Whitehead, **new species**

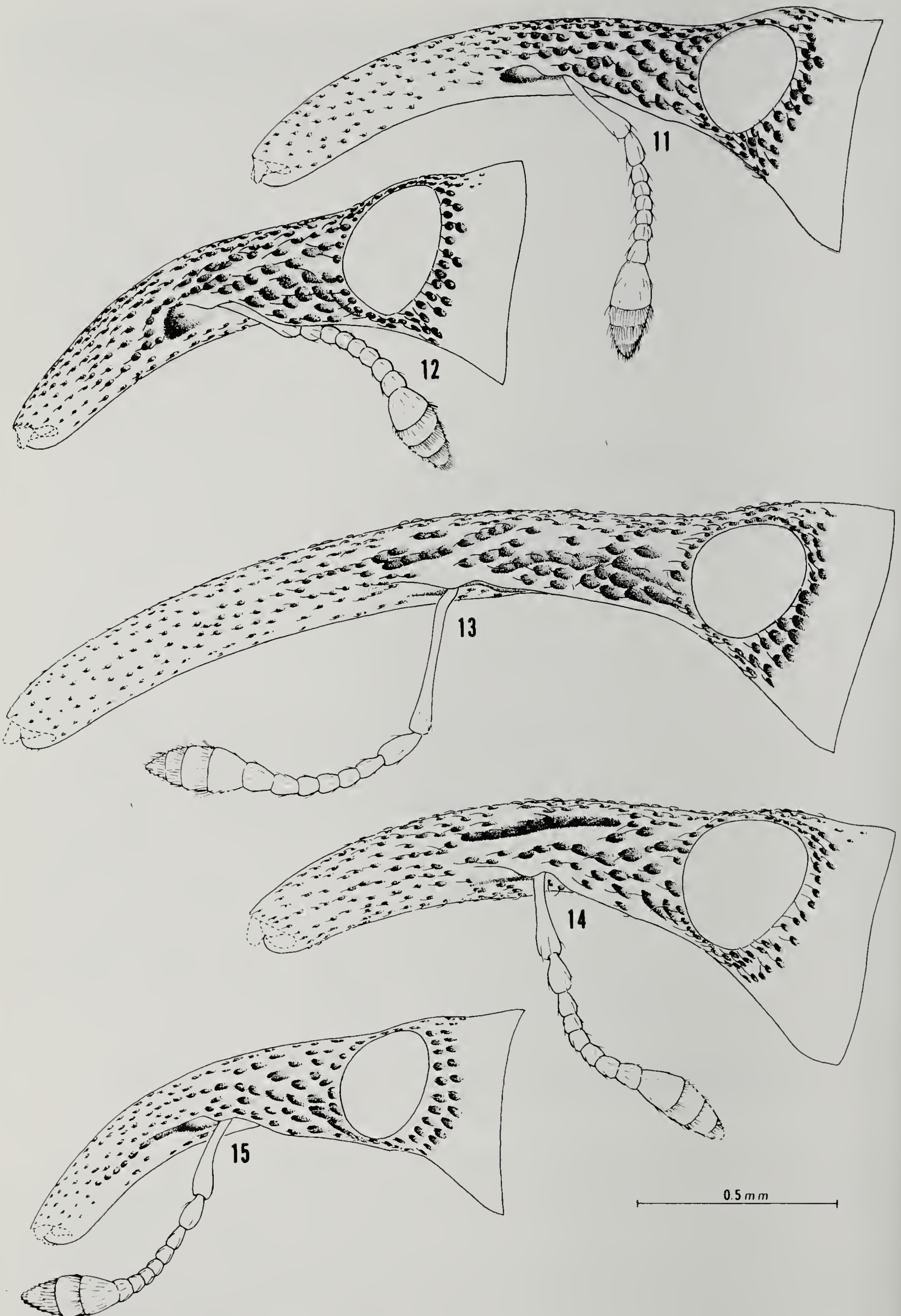
Figs. 8-9, 13-14, 19-21

Type-material. Holotype male (USNM #75313), allotype female, and 2 paratypes labelled "MEXICO. intercepted San Antonio 004677 (73-4781) / ex fruit Pterocarpus amphymenium DC.". In U.S. National Museum of Natural History.

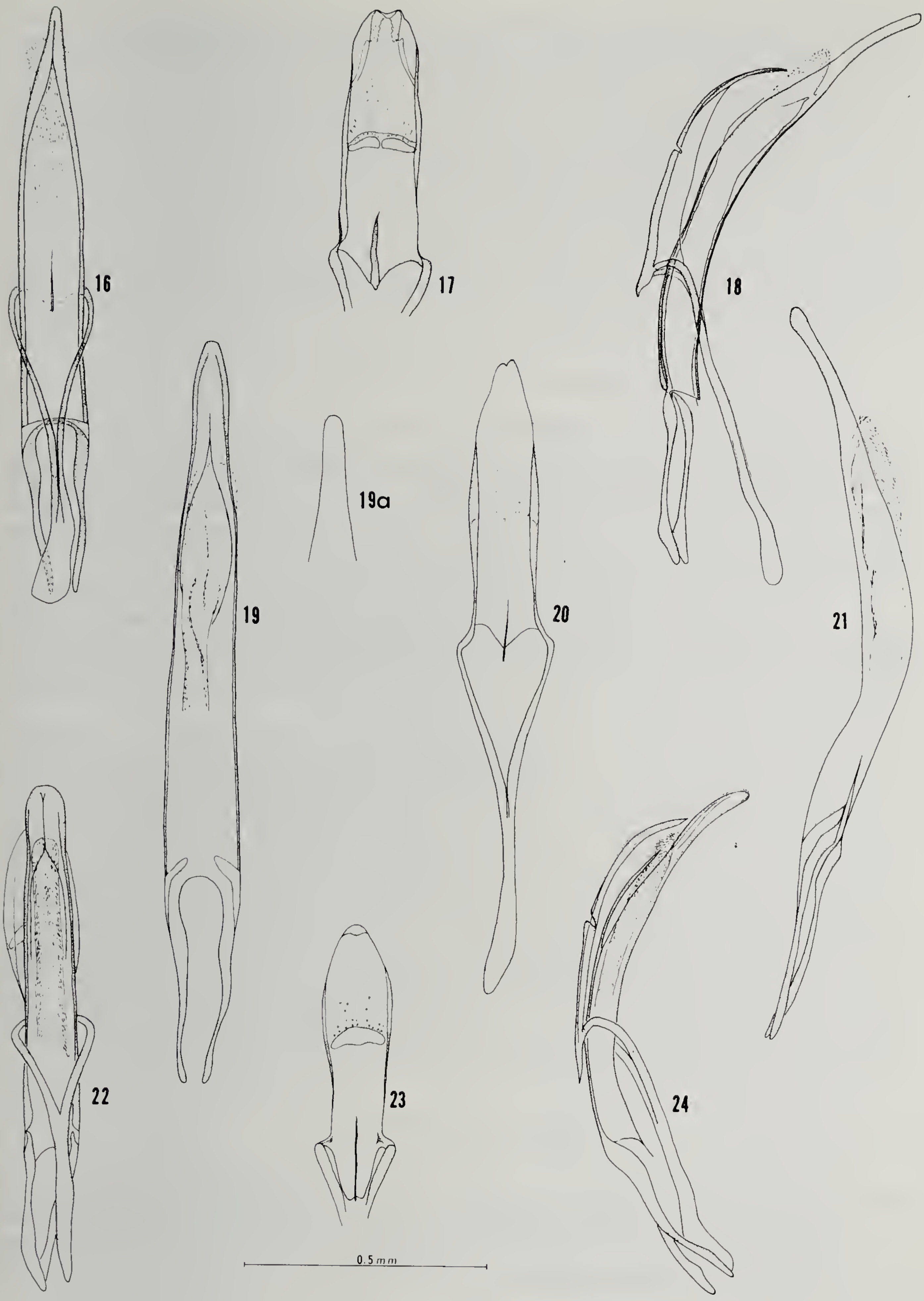
Comments. I am pleased to name this species for the late Prof. Bailey B. Pepper of Rutgers University. The host species is *Pterocarpus orbiculatus* DC, although USNM herbarium specimens were determined as *P. amphymenium* DC by J. P. Rojo in 1969. Fruits of this species are strongly pubescent and thus are easily distinguished from other Mexican and Central American *Pterocarpus*; determination of the host plant was made by me, from fruit samples submitted with the beetles. The collection supposedly originated from Mexico City, but the host species occurs at lower elevations (up to about 1000 m, in Guerrero, Jalisco, Michoacán, and Oaxaca as judged from USNM herbarium material). From this host distribution, I suspect that *A. pepperi* is endemic to central Mexico.



Figs. 6-10, *Apion* spp., dorsal view of head: 6, *A. pterocarpi*, female; 7, same, male; 8, *A. pepperi*, female; 9, same, male; 10, *A. cartwrightí*, male.



Figs. 11-15, *Apion* spp., lateral view of head: 11, *A. pterocarpi*, female; 12, same, male; 13, *A. pepperi*, female; 14, same, male; 15, *A. cartwrighti*, male.



Figs. 16-24, *Apion* spp., male genitalia, showing ventral view, paramere, and lateral view: 16-18, *A. pterocarpi*; 19-21, *A. pepperi* (ventral and lateral views shown without paramere; 19a shows variation in apex of phallus); 22-24, *A. cartwrighti*.

Description. Similar to *A. pterocarpi* except as follows. Length 3.68-3.80 mm; width 1.44-1.46 mm. Vestiture longer, conspicuous at low magnification. Male beak (figs. 9, 14) 1.19-1.24 × longer than prothorax; female beak (figs. 8, 13) 1.91-1.96 × longer than prothorax. Antenna inserted at basal 0.32-0.36 of beak, at distance in front of eye 2.4-2.5 (male) or 3.1-3.2 (female) × greater than width of frons. Frons 0.73-0.91 × as wide as apex of beak. Prothorax at base 1.14-1.19 × wider than long, apex 0.60-0.62 × as wide as base; on dorsal surface punctures 0.05-0.06 mm in diameter, bearing scales mostly 0.05-0.06 mm long; basal fovea in some specimens linear. Elytra at humeri 1.30-1.31 × wider than prothorax at base, 2.85-2.91 × longer than pronotum, 1.85-1.90 × longer than wide; scales on intervals conspicuous, about 2/3 as long as those of pronotum, strial scales about 1/2 as long as those of intervals. Phallus (figs. 19, 21), apex less strongly narrowed. Paramere (fig. 20), apical lobes narrower.

Apion (Coelocephalapion) cartwrighti Whitehead, **new species**

Figs. 10, 15, 22-24

Type-material. Holotype male (USNM #75314) labelled "Turrialba Costa Rica 6 June 1951 OLCartwright"; male paratype labelled "Hamburgfarm StaClaraPr CostaRica Nov. 22 1921/Nevermann Collection 1940". In U.S. National Museum of Natural History.

Comments. It is my pleasure to dedicate this species to Oscar Cartwright, emeritus Smithsonian entomologist. *A. cartwrighti* occurs in a region occupied by 3 or 4 species of *Pterocarpus*, and I predict that one of them is its host plant. *A. cartwrighti* and *A. pterocarpi,* presently known from different areas in Costa Rica, probably are sympatric.

Description. Similar to *A. pterocarpi* except as follows (female not known). Length 2.80-2.90 mm; width 1.20-1.29 mm. Vestiture less conspicuous. Male beak (figs. 10, 15) 1.21-1.29 × longer than prothorax; surface conspicuously alutaceous throughout except for polished calluses; punctures much less coarse and dense, interspaces broad and flat, vestiture minute. Antenna inserted at basal 0.35-0.38 of beak, at distance in front of eye 2.0-2.1 × greater than width of frons; dorsal margin of scrobe less angulate at antennal insertion. Frons 0.85-0.90 × as wide as apex of beak, with 2 rows of coarse punctures separated by low, irregular median and lateral carinae. Prothorax at base 1.13-1.23 × wider than long, apex 0.50-0.58 × as wide as base; on dorsal surface punctures less dense, bearing minute scales about 0.02-0.03 mm long; basal fovea more elongated. Scutellum ovate. Elytra at humeri 1.39-1.42 × wider than pronotum at base, 2.70-2.86 × longer than pronotum, 1.69-1.72 × longer than wide; on apex striae join 1 + 9; 3 + 4; 5 + 6; 7 + 8. Phallus (figs. 22, 24), apex broad. Paramere (fig. 23), apical lobes undivided; basal median projection long.

REFERENCE CITED

KISSINGER, D. G. 1968. Curculionidae subfamily Apioninae of North and Central America, with reviews of the world genera of Apioninae and world subgenera of *Apion* Herbst (Coleoptera). Taxonomic Publications, South Lancaster, Mass. vii + 559 p.

* * *

A LIST OF TYPES OF CERAMBYCIDAE AT THE FIELD MUSEUM OF NATURAL HISTORY, CHICAGO
(Coleoptera)

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Abstract

The Field Museum contains 125 primary types of Cerambycidae, including 11 lectotypes herein designated for species of *Moneilema* and *Romaleum*. This list includes label data and original literature citations for each.

With the recent acquisition of the Josef N. Knull collection of North American Coleoptera, the Field Museum has attained added stature and importance as a repository of Coleoptera. The more than 23,000 specimens of Cerambycidae include most of the known species of the United States, and the 68 primary types further enhance the collection. This collection, along with the previously acquired Dillon and Psota collections, makes it desirable to list the holotypes of Cerambycidae now in the collections of the Field Museum. Several species, particularly those of *Moneilema*, require lectotype designations which are so indicated here.

Thanks are due to the authorities and staff of the Field Museum, particularly Henry Dybas, Rupert Wenzel and John Kethley, for their hospitality and use of facilities there.

Aneflomorpha parkeri Knull. Holotype (sex?).
Pinal Mts., Arizona, August 12. F. H. Parker.
1934. Ohio Jour. Sci. 34:334.
Aneflus fisheri Knull. Holotype male.
Globe, Arizona, July 10. F. H. Parker.
1934. Ohio Jour. Sci. 34:335.
Aneflus paracalvatus Knull. Holotype male.
Santa Rita Mts., Arizona, July 11, 1949. D. J. & J. N. Knull.
1955. Ent. News 66:221.
Anoplium tricallosum Knull (= *Xeranoplium*). Holotype (sex?).
Sabino Canyon, Arizona, July 25, 1936. J. N. Knull.
1938. Ann. Ent. Soc. Amer. 31:140, fig. 7.
Anoplocurius altus Knull. Holotype male.
Davis Mts., Texas, July 2, 1940. D. J. & J. N. Knull.
1942. Ent. News 53:224.
Anthophilax quadrimaculatus Champlain & Knull (= *Centrodera*). Holotype female.
Rock Bridge, Ohio, June. R. J. Sim & C. J. Drake.
1922. Ent. News 33:147.
Astylidius versutus downiei Dillon. Holotype male.
Tippecanoe Co., Indiana, June 21, 1953. N. M. Downie.
1956. Ann. Ent. Soc. Amer. 49:150.
Ataxia brunneus Champlain & Knull. Holotype female.
Northern Illinois.
1926. Ent. News 37:206.
Atimia huachucae Champlain & Knull. Holotype female.
Cooney, New Mexico.
1922. Ent. News 33:148.
Batyle rufiventris Knull. Holotype female.
Sierra Ancha Mts., Gila Co., Arizona. D. K. Duncan.
1928. Ent. News 39:126.
Cacoplia nebulosa albata Knull. Holotype male.
Mobile, Alabama, May 25, 1952. W. Rosenburg.
1960. Ent. News 71:116.

Cacostola fuscata Dillon & Dillon. Holotype female.
Amazonas, Brasil.
1952. Ann. Ent. Soc. Amer. 45:71.
Ceresium cylindricellum Gressitt. Holotype female.
Hollandia, northern New Guinea, May, 1945. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:11.
Charoides hebes Dillon & Dillon. Holotype female.
Quiroz, Peru. F. Woytkowski.
1945. Reading Pub. Mus. Art Gall. Sci. Publ. 5:59, pl. 4, fig. 2.
Charoides obliquefasciata Dillon & Dillon. Holotype male.
São Paul d'Olivenca, Brasil. M. de Mathan.
1952. Ann. Ent. Soc. Amer. 45:61.
Charoides subcostata Dillon & Dillon. Holotype male.
Quiroz, Peru, April 10, 1932.
1945. Reading Pub. Mus. Art Gall. Sci. Publ. 5:61, pl. 4, fig. 3.
Clavidesmus indistinctus Dillon & Dillon. Holotype female.
Bahia, Brasil.
1952. Ann. Ent. Soc. Amer. 45:74.
Conosphaerion pullum Knull (= *Pseudoperiboeum*). Holotype female.
5 miles N. Nogales, Arizona, July 30, 1957. D. J. & J. N. Knull.
1958. Ent. News 69:185.
Delilah subfasciata Dillon & Dillon. Holotype female.
Tarapoto, Peru.
1952. Ann. Ent. Soc. Amer. 45:61.
Dorcaschema octovittata Knull. Holotype male.
Davis Mts., Texas, July 3, 1936. J. N. Knull.
1937. Ohio Jour. Sci. 37:307.
Eburia stroheckeri Knull. Holotype male.
Matheson Hammock, Dade Co., Florida, June 4, 1948. H. F. Strohecker.
1949. Ohio Jour. Sci. 49:104, fig. 1.
Elaphidion albomaculatum Champlain & Knull (= *Elaphidionoides*). Holotype (sex?).
Miami, Florida, April 2. J. N. Knull.
1922. Ent. News 33:146.
Elaphidion (Anepsyra) delongi Champlain & Knull (= *Aneflomorpha*). Holotype male.
Miami, Florida, April 13. D. M. Delong.
1922. Ent. News 33:147.
Elaphidion (Anoplium) duncani Knull (= *Caccophrissus*). Holotype female.
Globe, Arizona D. K. Duncan.
1927. Ent. News. 38:117.
Elaphidion (Anoplium) hoferi Knull (= *Peranoplium*). Holotype male.
Tucson, Arizona, June 4. G. Hofer.
1934. Ent. News 45:69.
Elaphidion knulli Linsley. Holotype male.
Miami, Florida, March, 1937.
1957. Amer. Mus. Nov. 1828:18.
Elaphidion linsleyi Knull. Holotype male.
Davis Mts., Jeff Davis Co., Texas. July 3, 1955. D. J. & J. N. Knull.
1960. Ohio Jour. Sci. 60:7.
Elaphidion (Anoplium) magnipunctata Knull (= *Gymnopsyra*). Holotype (sex?).
Grant Co., New Mexico, July 15. R. T. Kellogg.
1934. Ent. News 45:12.
Elaphidion (Anoplium) masoni Knull (= *Tylonotus*). Holotype female.
Edgebrook, Illinois, June 18.
1928. Ent. News 39:11.
Elytroleptus davisi Knull. Holotype (sex?).
Davis Mts., nr. Fort Davis, Texas, June 10, 1939. D. J. & J. N. Knull.
1940. Ann. Ent. Soc. Amer. 33:558, fig. 6
Elytroleptus immaculipennis var. *obliquus* Knull. Holotype female.
Davis Mts., Texas, July 3, 1940. D. J. & J. N. Knull.
1950. Ent. News 61:91.
Elytroleptus lineatus Knull. Holotype female.
Davis Mts., Texas, June 21, 1949. D. J. & J. N. Knull.
1950. Ent. News 61:91.

Eplophorus auricomis Chemsak. Holotype male.
Turrialba, Costa Rica, June-July, 1946. K. W. Cooper.
1969. Pan-Pacific Ent. 45:309.
Euderces balli Knull. Holotype (sex?).
Baboquivori Mts., Arizona, July 26. E. D. Ball.
1935. Ent. News. 46:192.
Eupogonius arizonensis Knull. Holotype female.
Ruby, Arizona, August 4, 1953. D. J. & J. N. Knull.
1954. Ent. News 65:127.
Eupogonius fraxini Knull. Holotype male.
Hummelstown, Pa., July 21, 1917.
1918. Ent. News 29:132.
Euryptera sabinoensis Knull (= *Choriolaus*). Holotype female.
Sabino Canyon, Santa Catalina Mts., Arizona, July 11, 1952. D. J. & J. N. Knull.
1954. Ohio Jour. Sci. 54:129.
Euryptera texana Knull (= *Megachoriolaus*). Holotype female.
Davis Mts., Texas, July 3, 1940. D. J. & J. N. Knull.
1941. Ohio Jour. Sci 41:388, fig. 1.
Eutrichillus canescens nelsoni Dillon. Holotype male.
Prescott, Arizona, August 21, 1953. G. H. Nelson.
1956. Ann. Ent. Soc. Amer. 49:223.
?Examnes longipes Gressitt. Holotype male.
Hollandia, northern New Guinea, Dec. 13, 1944. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:14.
Glaucytes quadrifasciata Gressitt. Holotype male.
Hollandia, northern New Guinea, Dec. 24, 1944. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:210, fig. 5.
(Published as being deposited in the California Academy of Sciences.)
Goes pulcher var. *fuscatus* Knull. Holotype male.
McCurtain Co., Okla., June 27. A. Elred.
1944. Ohio Jour. Sci. 44:92.
Gymnospyra notabilis Knull (= *Hesperanoplium*). Holotype female.
Jacumba, California, May 18, 1941. D. J. & J. N. Knull.
1947. Ohio Jour. Sci. 47:72.
Haplidus laticeps Knull. Holotype male.
Sonora, Texas, April, 1931.
1941. Ann. Ent. Soc. Amer. 34:317.
Hirsutographis pulchra Dillon. Holotype female.
South Miami, Florida, June 2, 1952. D. G. Kissinger.
1956. Ann. Ent. Soc. Amer. 49:207.
Hyphus comusioides Gressitt. Holotype male.
Hollandia, northern New Guinea, May, 1945. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:4, fig. 4.
Idomea bicolor Champlain & Knull (= *Styloxus*). Holotype (sex?).
Jemez Springs, New Mexico, August. J. Woodgate.
1922. Ent. News 33:145.
Iphra euderceoides Gressitt. Holotype female.
Hollandia, northern New Guinea, Dec. 24, 1944. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:23, fig. 7.
Jamesia duofasciata Dillon & Dillon. Holotype (male?).
Balzapamba, Prov. de Bolivar, Ecuador.
1952. Ann. Ent. Soc. Amer. 45:59.
Jamesia fuscofasciata Dillon & Dillon. Holotype female.
Balzapamba, Prov. Bolivar, Ecuador.
1952. Ann. Ent. Soc. Amer. 45:60.
Lagocheirus araneiformis fulvescens Dillon. Holotype male.
British Guiana, Jan. 18, 1912. A. F. Porter.
1957. Bull. British Mus. (Nat. Hist.) Ent. 6(6):151.
Lagocheirus dezayasi Dillon. Holotype male.
Havana, Cuba. F. de Zayas.
1957. Bull. British Mus. (Nat. Hist.) Ent. 6(6):144.
Lagocheirus wenzeli Dillon. Holotype male.
Near Compostela, Nayarit, Mex., June 29, 1933.
1957. Bull. British Mus. (Nat. Hist.) Ent. 6(6):146.

Lagocheirus zimmermani Dillon. Holotype female.
Honolulu, Oahu, Hawaii, January, 1907.
1952. Ent. News, 63:207.
Leiopus imitans Knull. Holotype. (sex?).
Davis Mts., Texas, June 13, 1935. J. N. Knull.
1936. Ent. News 47:107.
Leptostylus floridanus Champlain & Knull. Holotype (sex?).
Miami, Florida, April 3. J. N. Knull.
1922. Ent. News 33:148.
Leptostylus monki Knull. Holotype (sex?).
Donna, Texas. J. W. Monk.
1936. Ent. News 47:106.
Leptura splendens Knull. Holotype female.
Globe, Arizona. D. K. Duncan.
1935. Ent. News 46:191.
Lepturges minutus Champlain & Knull. Holotype (sex?).
Slidell, Louisiana, July 2.
1925. Ent. News 36:207.
Lepturges neomexicanus Champlain & Knull. Holotype male.
Jemez Springs, New Mexico, July 17.
1925. Ann. Ent. Soc. Amer. 18:470.
Longipalpus saipanensis Gressitt. Holotype female.
Tuturam, Laulau Bay, Saipan I., S. Mariana Is., Jan. 21, 1945. H. S. Dybas.
1956. Insects of Micronesia 17:100, fig. 9, b.
Mecas linsleyi Knull. Holotype male.
Bentsen Rio Grande State Park, Hidalgo Co., Texas, March 26, 1954. D. J. & J. N. Knull.
1975. Ohio Jour. Sci. 75:130, fig. 1.
Methia acostata Linsley. Holotype male.
Hualpai, Arizona, July 3. D. J. & J. N. Knull.
1940. Ent. News 51:287.
Methia carinata Linsley. Holotype female.
Hualpai, Arizona, July 2. D. J. & J. N. Knull.
1940. Ent. News 51:289.
Methia dubia Linsley. Holotype male.
Wickenberg, Arizona, June 16. D. J. & J. N. Knull.
1940. Ent. News 51:286.
Methia evaniformis Knull (= *Coleomethia*). Holotype male.
Davis Mts., Texas, July 3. J. N. Knull.
1937. Ohio Jour. Sci. 37:306, fig. 3.
Methia knulli Linsley. Holotype female.
Hualpai, Arizona, July 3. D. J. & J. N. Knull.
1940. Ent. News 51:288.
Methia lata Knull. Holotype female.
Chisos Mts., Texas, June 30, 1957.
1958. Ohio Jour. Sci. 58:282.
Molorchus bimaculatus celti Knull. Holotype. (sex?).
Hummelstown, Pennsylvania, December. J. N. Knull.
1930. Ent. News 41:101.
Moneilema alpinum Psota. Holotype male.
Albuquerque, New Mexico, June 27. H. F. Wickham.
1930. Coleop. Contr. 1:126, pl. 4, fig. 6.
Moneilema angulatum Psota. Holotype (sex?).
Pullman, Washington, July.
1930. Coleop. Contr. 1:122.
Moneilema corrugans var. *arizonicum* Psota. Holotype male.
Huachuca Mts., Arizona.
1930. Coleop. Contr. 1:128, pl. 3, fig. 6.
Moneilema corpulenta Knaus. Holotype male.
Globe, Arizona, July 7, 1921.
1925. Pan-Pacific Ent. 1:183.
Moneilema duncani Psota. Lectotype male, here designated.
Base of Pinal Mts., Gila Co., Arizona, August. D. K. Duncan.
1930. Coleop. Contr., 1:128.

Moneilema hybrida Psota. Holotype male.
Walsenburg, Colorado, June 20, 1922. F. Psota.
1930. Coleop. Contr. 1:123, pl. 3, fig. 8.
Moneilema isolatum Psota. Lectotype male, here designated.
Rio Grande, New Mexico, August 1, 1927. F. Psota.
1930. Coleop. Contr. 1:132.
Moneilema manni Psota. Lectotype male, here designated.
San Miguel. W. M. Mann.
1930. Coleop. Contr. 1:139, pl. 9, figs. 4-8, pl. 24, figs. 1-2.
Moneilema annulatum var. *montanum* Psota. Lectotype male, here designated.
Jordan, Montana, August 15, 1917. L. Wallers.
1930. Coleop. Contr. 1:121, pl. 1, figs. 3,5; pl. 10, figs. 3-4.
Moneilema parahybrida Psota. Holotype male.
Delia, New Mexico, July 22, 1922. F. Psota.
1930. Coleop. Contr. 1:124, pl. 3, fig. 9, pl. 13, fig. 2.
Moneilema punctatum Psota. Lectotype male, here disignated.
Bethage, Texas.
1930. Coleop. Contr. 1:133, pl. 14.
Moneilema puncticollis Psota. Lectotype male, here designated.
Walsenburg, Colorado, June 20, 1922. F. Psota.
1930. Coleop. Contr. 1:121, pl. 2, fig. 7, pl. 3, fig. 7.
Moneilema rinconi Psota. Lectotype male, here designated.
Rincon, New Mexico, August 22, 1922. F. Psota.
1930. Coleop. Contr. 1:126, pl. 2, fig. 4, pl. 4, fig. 5.
Moneilema appressum var. *scabrum* Psota. Lectotype female, here designated.
Santa Fe, New Mexico, July 21, 1922. F. Psota.
1930. Coleop. Contr. 1:125, pl. 4, fig. 3, pl. 13, fig. 1.
Moneilema texanum Psota. Holotype male.
Alpine, Texas, June 26-28, 5400 ft. H. F. Wickham.
1930. Coleop. Contr. 1:127, pl. 4, fig. 7
Moneilema walsenburgi Psota. Lectotype male, here designated.
Walsenburg, Colorado, June 20, 1922. F. Psota.
1930. Coleop. Contr. 1:140, pl. 8, figs. 1-2, pl. 13, figs. 5-6.
Moneilema wickhami Psota. Lectotype male, here designated.
Durango, Mexico. H. F. Wickham.
1930. Coleop. Contr. 1:138, pl. 22, figs. 1,2.
Neoleptura auripennis Chemsak & Linsley. Holotype male.
Cerro Tancitaro, Michoacan, Mexico, 10,600 ft., July 18, 1941. Hoogstraal & Haig.
1976. Jour. Kansas Ent. Soc. 49:183, fig. 2.
Nyssodectes veracruzi Dillon. Holotype male.
"San Andres", Vera Cruz, Mexico, February 6-12, 1953. D. G. Kissinger.
1955. Ent. News 66:143.
Obrium howdeni Knull. Holotype female.
Reelfoot Biological Station, Obion Co., Tennessee, June 20-27, 1948. Pfitzer & Scott.
1955. Ent. News 66:139.
Oncideres albifasciata Dillon & Dillon. Holotype male.
Brasil.
1952. Ann. Ent. Soc. Amer. 45:78.
Oncideres albistillata Dillon & Dillon. Holotype male.
Tarapoto, Peru.
1952. Ann. Ent. Soc. Amer. 45:76.
Oncideres ochreomaculata Dillon & Dillon. Holotype female.
Oricabo, British Guiana.
1952. Ann. Ent. Soc. Amer. 45:77.
Oncideres ochreostillata Dillon & Dillon. Holotype female.
Santa Dounrya?, Brasil.
1952. Ann. Ent. Soc. Amer. 45:75.
Oxoplus tumacacorii Knull (= *Deltaspis*). Holotype male.
Tumacacori Mts., Ariz., August 24, 1940. D. J. & J. N. Knull.
1944. Ohio Jour. Sci. 44:91, fig. 1.
Paraopsimus bidentatus Champlain & Knull (= *Dicentrus*). Holotype female.
Subalpine Region. A. L. Lovett.
1926. Ent. News 37:205.

Phymatodes ursae Knull. Holotype (sex?).
Yellowstone National Park, July 12, 1939. D. J. & J. N. Knull.
1940. Ann. Ent. Soc. Amer. 33:556, fig. 5.
Plagiohammus camillus Dillon & Dillon. Holotype male.
Peru. F. Woytkowski.
1949. Amer. Mus. Nov. 1388:3.
Psapharochrus quadrigibbus lucidus Knull. Holotype female.
Brownsville, Texas, May 7, 1934. J. N. Knull.
1958. Ohio Jour. Sci. 58:282.
Rhopalophora prorubra Knull. Holotype (sex?).
Sabino Canyon, Santa Catalina Mts., Arizona, August 13, 1936. J. N. Knull.
1944. Ohio Jour. Sci. 44:91, fig. 7.
Romaleum cortiphagus Craighead (= *Enaphalodes*). Lectotype (sex?), here designated.
Charter Oak, Pa., June 22, 1917. H. B. Kirk.
1923. Canada Dept. Agr. Bull. 27(n.s.):69
Romaleum cylindricum Knull (= *Enaphalodes*). Holotype (sex?).
Paradise, Arizona. H. H. Kimball
1927. Ent. News 38:116.
Romulus globosus Knull. Holotype male.
Coral Gables, Fla., May 20, 1943. H. Conger.
1948. Ohio Jour. Sci. 48:83, fig. 1.
Sciadella (Sciadella) iwojimana Gressitt. Holotype male.
Iwo Jima, Volcano Is., Sept. 1-5, 1945. H. S. Dybas.
1956. Insects of Micronesia 17:162, fig. 27,a.
Smodicum arizonarium Knull. Holotype female.
Chiricahua Mts., 1 mile S. Portal, Cochise Co., Arizona, July 2, 1965. D. J. & J. N. Knull.
1966. Ent. News 77:136.
Smodicum texanum Knull. Holotype female.
Bentsen Rio Grande Valley State Park, Hidalgo Co., Texas, March 29, 1964. D. J. & J. N. Knull.
1966. Ent. News 77:137.
Stenosphenus piceus Knull. Holotype male.
Davis Mts., Texas, July 1. D. J. & J. N. Knull.
1946. Ent. News 57:253.
Stenosphenus texanus Knull. Holotype male.
Davis Mts., Texas, July 3. D. J. & J. N. Knull.
1946. Ent. News 57:254.
Strangalia dolicops Chemsak. Holotype male.
Santa Clara, in interior valley of Sierra de las Minas (N of Cabañas), Zacapu, Guatemala, August 6, 1948. R. D. Mitchell
1969. Jour. New York Ent. Soc. 78:3, fig. 2.
Syllitus sexlineatus Gressitt. Holotype female.
Hollandia, northern New Guinea, Dec. 24, 1944. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:27, fig. 10.
Taranomis linsleyi Knull. Holotype male.
Phoenix, Arizona, May 2, 1925. R. H. Crandall.
1942. Ent. News 53:226.
Tethionea bidentata Gressitt. Holotype male.
Hollandia, northern New Guinea, Feb. 20, 1945. H. Hoogstraal.
1955. Proc. Hawaiian Ent. Soc. 15:414, figs. 5, 11, 19.
Tethionea brevicollis Gressitt. Holotype female.
Hollandia, northern New Guinea, April 17, 1945. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:15.
Tethionea hollandae Gressitt. Holotype female.
Hollandia, northern New Guinea, May 6, 1945. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:16.
Tethionea hoogstraali Gressitt. Holotype male.
Hollandia, northern New Guinea, Dec. 24, 1944. H. Hoogstraal.
1951. Ann. Ent. Soc. Amer. 44:16, fig. 2.
Tragidion opacum Knull (= *Purpuricenus*). Holotype male.
Davis Mts., Texas, July 4, 1936. J. N. Knull.
1937. Ohio Jour. Sci. 37:306.

Tybalmia breuningi Dillon & Dillon. Holotype female.
    Colombia.
    1952. Ann. Ent. Soc. Amer. 45:66.
Tylonotus champlaini Knull (= *Penichroa*). Holotype (sex?).
    Glenside, Pa., June 19, 1934. H. J. Fisher.
    1941. Ann. Ent. Soc. Amer. 34:695, fig. 1.
Typocerus brunneus inflatus Knull. Holotype male.
    Southern Pines, N.C. May 20, 1916. A. H. Manee.
    1959. Ohio Jour. Sci. 59:47, fig.
Typocerus deceptus Knull. Holotype (sex?).
    Clark's Valley, Pa.
    1929. Ent. News 40:144.
Typocerus fulvocinctus Knull. Holotype female.
    Sebring, Florida, April, 1954. L. A. Hetrick.
    1956. Ohio Jour. Sci. 56:338, fig.
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    1956. Ann. Ent. Soc. Amer. 49:337.
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    1970. Arq. Zool. 16:964, figs. 496, 501.
    (This type was erroneously cited as being in the Carnegie Museum).

* * *

TYPOCERUS DECEPTUS KNULL IN ILLINOIS, WITH DISCUSSION OF HABITAT (COLEOPTERA: CERAMBYCIDAE)

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ABSTRACT

Typocerus deceptus Knull is reported for the first time from Illinois on the basis of collections made by the author in areas of extremely sandy soils. Certain black oaks are tentatively suggested to be possible hosts of this rarely collected beetle.

Typocerus deceptus Knull is one of the least known longhorned beetles found in the eastern United States. The species was described by Knull (1929) on the basis of "a small series of both sexes all but one of which were collected by the author in Clark's Valley, north of Harrisburg [Pennsylvania] during July and August, on the flowers of the smooth sumac (*Rhus glabra*)." The foregoing quotation states almost everything that has appeared in the literature pertaining to this species. Knull (1946) included *T. deceptus* in his work on the cerambycid beetles of Ohio, but without mentioning specific localities in that state for the beetle. Recently, Linsley and Chemsak (1976) have added Indiana, Virginia, and South Carolina to the known range of the species.

I have collected *Typocerus deceptus* several times in Illinois (see records below), most notably at Sand Ridge State Forest near the Illinois River in Mason County. The purpose of this paper is to give the first records for the species in Illinois and to discuss briefly the ecological setting of the captures. The latter might help other investigators find this seldom encountered beetle in their areas.

At Sand Ridge State Forest I have taken *Typocerus deceptus* from flowers of New Jersey tea, *Ceanothus americanus* L. (Rhamnaceae), and dogwood, *Cornus* sp. (Cornaceae), growing along and within oak-hickory woods. Other anthophilous cerambycids taken in the company of *T. deceptus* on these flowers include *Callimoxys sanguinicollis* (Olivier), *Strangalia famelica* Newman, and *Typocerus lugubris* (Say). *Typocerus velutinus* (Olivier), the near sibling of *T. deceptus,* also occurs, and I have taken it in the company of *T. deceptus.*

Sand Ridge State Forest is located in an area of surficial sand deposits of glaciofluvial origin (Hart and Gleason 1907), and the vegetation is of a decidedly xerophytic nature (Gleason 1910). Sand prairie alternates with a rather openly structured woodland or forest composed mainly of black oak, *Quercus velutina* Lam., blackjack oak, *Q. marilandica* Muenchh., and scrubby hickory, *Carya* sp. The forest is developed on stabilized dunic terrain. The situation in Kankakee County near Wichert is similar, but with the substitution of Hill's oak, *Quercus ellipsoidalis* E. J. Hill., as the main woody species. *Typocerus deceptus* may be associated with one or more of these black oaks.

Specimens cited.—ILLINOIS: *Kankakee County,* 2 mi. E. of Wichert, 16-VII-1960, 1 male; *Mason County,* Mason [now Sand Ridge] State Forest, 6-VII-1958, *Ceanothus americanus,* 4 males, 3 females; 30-VII-1960, 2 males; 25-VI-1961, *Cornus* sp., 1 male, 1 female; 29-VI-1967, *Ceanothus americanus,* 3 males, 2 females; Sand Ridge State Forest, 3-VII-1973, *C. americanus,* 1 male, 1 female; *Tazewell County,* 1 mi. SW. Spring Lake Conservation Area, 27-VI-1973, *C. americanus,* one male. All collections by John K. Bouseman. Specimens currently in the collection of the author.

Sincere thanks are due to William G. Ruesink of the Illinois Natural History Survey at Urbana for his comments on a version of this paper.

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* * *

NOTES ON HABITATS AND PARASITOIDS OF SOME CERAMBYCIDAE OF WESTERN WASHINGTON

Mark Deyrup

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Abstract

Original information on larval habitats and insect associates is presented for 15 species of cerambycids. Associates include Hymenoptera (Braconidae, Ichneumonidae, Eurytomidae, Pteromalidae, Eupelmidae), Coleoptera (Elateridae), and Neuroptera (Raphidiidae). Coniferous hosts are cited for *Plectrura spinicauda.*

A recent study of the insect fauna of dead Douglas-fir trees has produced new information on some cerambycids of western Washington. During this study cerambycid larvae and their associates were reared in 100 × 15 mm. Optilux Petri dishes (Falcon Plastics, Oxnard, Calif.). Immature insects accompanied by a small piece of bark or wood were placed on a small pad of paper toweling in the petri dishes; the toweling was moistened with a few drops of water every other day. Reared specimens are in the author's collection.

This work was supported by National Science Foundation grant no. GB-20963 to the Coniferous Forest Biome, Ecosystem Analysis Studies, U.S./International Biological Program. Braconids were identified by Dr. Paul Marsh at the U.S. National Museum. My wife Nancy assisted in collection of cerambycid-bearing material and in the preparation of this manuscript.

Dicentrus blunthneri LeConte. This is the most abundant cerambycid in shaded fallen branches of Douglas-fir in western Washington. The life cycle is completed in one year; pupation occurs in early spring. Parasitoids of *D. bluthneri* include the ichneumonid *Helcostizus albator albator* (Thunberg) and the undescribed braconid *Ontsira* sp. *Eurytoma picea* Bugbee (Eurytomidae) occurs as a hyperparasite of *H. albator,* but it may attack *D. bluthneri* as well. A specimen of *Calosota pseudotsugae* Burks was reared from the cocoon of one of the parasitoids; this eupelmid is normally a hyperparasitoid of scolytids. A raphidiid, *Agulla adnixa* Hagen, was also reared from galleries of *D. bluthneri;* although this species consumes larval *D. bluthneri* in the laboratory, it does not normally have access to occupied galleries in the field.

Plectrura spinicauda Mannerheim. Specimens were reared from branches of Douglas-fir and from a small *Tsuga heterophylla.* Host material ranged from 1.5-5 cm. in diamter, had been dead for no more than 1 year, and was lying on the ground in dense shade. Previously recorded hosts of *P. spinicauda* are *Acer glabrum, A. macrophyllum, Alnus rubra, A. sitchensis* (Hardy and Preece 1926), and *Oplopanax horridum* (Clark 1956).

Opsimus quadrilineatus Mannerheim. This species is apparently the most abundant cerambycid in sound wood of suppressed standing Douglas-fir in western Washington.

Eumichthus oedipus LeConte. One adult and several presumably conspecific larvae were found during October in a dry exposed dead branch of a live *Tsuga heterophylla* on the edge of the beach on Puget Sound. The previously known host is Douglas-fir (Linsley 1964).

Leptura obliterata Haldeman. This species is a common inhabitant of exposed conifers, particularly stumps of cut trees. Larvae are parasitized by the braconid *Wroughtonia necydalidis* (Cushman) and attacked by larvae of an unidentified asilid.

Monochamus scutellatus oregonensis LeConte. This is a common species in large exposed conifers. An unreported but not unexpected host found during the present study was *Tsuga heterophylla.*

Evodinus monticola vancouveri Casey. Larvae feed on succulent phloem of tops of shaded Douglas-fir and *Tsuga heterophylla*. Adults appear in early spring to feed, fight, and mate on woodland flowers such as *Trillium ovatum* and *Berberis nervosa*. Eggs are laid in fissures in the bark of recently killed trees.

Clytus pacificus Van Dyke. Larvae feed in the phloem and the surface of the sapwood of exposed Douglas-fir branches. Pupae and teneral adults are present in early spring. An undescribed pteromalid, *Neocatolaccus* sp., is a parasitoid of *C. pacificus*.

Xestoleptura behrensii LeConte. Two specimens were reared from soft rotton wood of shaded Douglas-fir.

Holopleura marginata LeConte. Larvae and teneral adults were found during April in fallen partly shaded Douglas-fir branches. Parasitoids include the ichneumonid *Helcostizus albator* (Thunberg) and the braconids *Ontsira* n. sp. and *Atanycolus longifemoralis* Shenefelt. The latter species was represented by two abnormally small males and is probably not a normal parasitoid of *H. marginata*. An elaterid larva was found consuming a larval *H. marginata*; this elaterid, fed larval scolytids and cerambycids in the laboratory, eventually transformed into an adult identified as *Ampedus anthracinus* LeConte.

Callidium antennatum Newman. This species was found only in exposed or partially exposed Douglas-fir. Branches as small as 2.7 cm. were attacked.

Phymatodes aeneus LeConte. This species was found breeding in small shaded Douglas-fir branches; it is parasitized by the ichneumonid *Helcostizus albator albator* (Thunberg).

Phymatodes maculicollis LeConte. Specimens reared from dry shaded Douglas-fir branches are entirely black, except for teneral specimens which have temporary testaceous lateral areas on the pronotum. *Phymatodes maculicollis* is parasitized by the ichneumonid *Helcostizus albator albator* (Thunberg), the eurytomid *Eurytoma picea* Bugbee, and the braconid *Allodorus* sp. Elaterid larvae were found consuming larval *P. maculicollis*; two of these larvae were reared to adults and proved to be *Ampedus anthracinus* LeConte.

Phymatodes nitidus LeConte. This species is common in shaded branches of *Thuja plicata*; the larvae are parasitized by the ichneumonid *Helcostizus albator albator* (Thunberg).

Leptalia macilenta (Mannerheim). Teneral adults were found during April under bark of a large shaded *Alnus rubra*.

Parasitoid records from unidentified cerambycid larvae

Doryctes fartus (Provancher) (Braconidae). This species is a parasitoid of small subcortical cerambycid and buprestid larvae in exposed Douglas-fir and *Tsuga heterophylla*.

Spathius sequoiae Ashmead (Braconidae) and *Dinotiscus acuta* (Provancher) (Pteromalidae). These species are normally parasitoids of scolytids in shaded conifers but occasionally attack small subcortical cerambycid larvae.

Xorides cincticornis (Cresson) (Ichneumonidae) and *Dolichomitus pygmaeus* (Walsh) (Ichneumonidae). A single specimen of each species was reared from subcortical cerambycid larvae in shaded Douglas-fir.

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THE COLEOPTERISTS NEWSLETTER

EDITORIAL

Here I shall include a brief editorial comment to open this new sequence of Newsletters. I'm pleased with the international flavor of the current contents and ask you *all* to contribute notes for future Newsletters.

Please send you notes typed and double spaced. We'll try to get them into print as soon as possible.

It's been suggested that we include an annual list of deceased Coleopterists with a bibliography of obituaries and of printed bibliographies. I think this is a fine idea and ask your cooperation to make this list reasonably complete. Send me a notice when you know of such a death and include citations whenever applicable.

Charles W. O'Brien
Laboratory of Aquatic
Entomology,
University P.O. Box 111,
Florida A & M University,
Tallahassee, FL 32307

* * *

INTERNATIONAL FAIR FOR THE EXCHANGE AND SALE OF INSECTS

Probably not many subscribers of this Newsletter have heard of the Insect Fair in Basel, Switzerland. It is organized by the Entomologische Gesellschaft Basel and takes place once a year on the last weekend of September. The 51st Fair on September 25/26, 1976, again was a full success. 187 exhibitors showed their treasures to the 860 visitors who had come from 9 countires. This fair is particularly interesting for Coleopterists, since 40% of the displayed material is Coleoptera, another 55% is Lepidoptera and about 5% belong to other insect orders. Of course the families most in demand such as Cicindelidae, Carabidae, Elateridae, Buprestidae, Scarabaeidae, Lucanidae and Cerambycidae are there, and also some extremely beautiful Chrysomelidae and Curculionidae. However, the specialist interested in less spectacular families, for example, Dytiscidae and others, will benefit from this event and also may find what he seeks.

Inquires may be sent to Mr. Andreas Schwabe, Spalenberg 28, CH-4012 BASEL (Switzerland).

Walter Wittmer
Naturhistorisches Museum Basel,
Augustinergasse 2,
CH-4051 Basel, Switzerland

THE COLEOPTERISTS NEWSLETTER

A COLLECTING AREA FOR COLEOPTERISTS

Many modern collectors are somewhat reluctant to venture into areas without some convenient home base from which to operate, and quite frequently this center of operation must provide not only an ideal vantage point which touches different types of environment but living conveniences for the collector as well. The Forestry School of Siguatepeque, Honduras is one such center.

The school is located at an elevation of 3,500 feet and is in the heart of typical Honduran pine forest. In addition to the Pinaceae about 25 additional plant families are represented. The area is classified ecologically as humid subtropical with an annual precipitation of nearly 120 cm., the wettest season occuring between May and October. The temperature ranges between about 40 to 95°F, with the warmest months being May and June and the coldest months being December and January when the temperature drops to nearly 40°F.

Within a distance of 25 miles from the school is the Comayagua Valley, a tropical desert region, typified by such plants as *Acacia, Agave nopalea,* prickly pear, and other such arid dwelling species. About the same distance north one enters a semitropical area replete with large assortments of broad-leaved plants. On the various peaks surrounding Siguatepeque are found rain and cloud forests. All of these regions and the transitional zones between them harbor great hosts of tropical insect fauna.

In addition to its unique position, the school has an Entomology Department which has a fair-sized insect collection with good representation of most of the beetle families, and a good cross-section of the other insect orders.

For research workers and visitors, the school has guest houses, a low-cost dining hall, and safe drinking water. No fees are charged at present for the use of the rooms for those willing to assist in the development of the collection or the school's entomology program. Only recently additional paved highways and other road improvements have made access into the more remote areas possible.

The purpose of the above information is to call to the attention of fellow coleopterists and other entomologists that here in Siguatepeque, Honduras our National Forestry School may be ideal as a base of operations for field work.

J. V. Mankins
Escuela Nacional de Ciencias
Forestales,
Siguatepeque, Honduras

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NOTICE TO AUTHORS

Manuscripts will be considered from any authors, although those from members of the Coleopterists Society are given priority. It is suggested that all prospective authors join the Society. All manuscripts should conform to instructions in the **Style Manual for Biological Journals** (3rd Ed.) prepared by the Committee on Form and Style of the Conference of Biological Editors, and published by the American Institute of Biological Sciences, 2000 P Street NW, Washington, DC 20063.

The following exceptions are noted: 1) all geographical names are to be spelled out, 2) use words, not symbols, for male and female, 3) use numerals throughout, except to begin a sentence, 4) entomology, -ical, -ist, etc. are to be abbreviated Ent. in literature citations.

Specimen label data should be listed in the following manner: MEXICO: State of Veracruz, Fortin de las Flores, 10-VIII-70, I. B. Jones, under bark of **Pinus moctezumae,** 7000ft. [USNM] (2). The number in parentheses indicates the number of specimens. Geographical names are listed in order with largest units first, with states, departments, provinces, parishes, and/or counties listed. Dates are listed by day, month (in Roman numerals), and last 2 digits of the year. Listing of ecological data is encouraged. Location of specimens should be shown in brackets; if the data are extensive these should be abbreviated as shown and the abbreviations listed in the text.

Any article concerning Coleoptera will be considered. Descriptions of new taxa must contain keys (or be correlated with existing keys) and illustrations. All manuscripts should be typed on 8½×11" opaque white paper with 1 inch margins. They should be typed on one side only and double spaced throughout (including title, footnotes, tables, figure legends, and references). All scientific names should be underlined. Use the following order: title, author, author's address, abstract, body of text, references cited, and figures. All footnotes, tables, and figure legends should be provided on separate sheets and double spaced. Indicate approximate figure and table locations in pencil in the margin of the manuscript.

An abstract is required for all articles longer than 2 manuscript pages. It should be a concise statement of the facts presented, not *that* they are presented (e.g., list actual conclusions derived from a discussion). This abstract is the key to how your article will be cited in abstracting journals and should be carefully written.

For the author's protection as well as for the editor's convenience, manuscripts should be submitted in duplicate. Manuscripts will be processed most rapidly if the authors have had them critically reviewed in advance; such critical reviews minimize the probability of rejection or major revision.

THE COLEOPTERISTS SOCIETY

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NOTICES

Notices to appear on this page are a free service to members and subscribers. Such copy will be limited to the back page, the older notices being moved up and replaced with the newest ones at the bottom. The editor reserves the right to reword such notices for brevity, consistency, and clarity.

STAPHYLINIDAE: If anyone wishes to send us unsorted Staphylinidae in 70% alcohol we will *eventually* return 1 or 2 specimens mounted, labeled and identified to the nearest possible taxon. Ecological data particularly desired. Ian Moore, Div. Biological Control, Univ. of California, Riverside, CA 92502.

SCARABAEIDAE: Studying myrmecophilous and termitophilous Aphodiinae. Request loan of New World material especially. Will sort from general scarab collections or from light trap samples. Robert E. Woodruff, Fla. Dept. Agr., P. O. Box 1269, Gainesville, FL 32601.

FOR SALE: 6m × 2.5m linear MALAISE TRAPS. Collecting heads utilize cyanide &/or alcohol. Proven design used worldwide. Additional information & prices write D. A. Focks, P. O. Box 12852, Gainesville, FL 32604.

EXCHANGE: Fernando Angelini, Via Imperiali "Villa Italia" n. 189/1B,72021 Francavilla Fontana (Brindisi), ITALY, wishes to receive Haliplidae, Dytiscidae, and Gyrinidae of North & South America in exchange for Coleoptera of same or other families from Italy.

EXCHANGE: Coleoptera of all Families from Arizona; ask for List and send yours. Dr. Rudolph Lenczy, 126 Los Robles, Green Valley, Arizona 85614.

LATHRIDIIDAE: Want specimens from entire world; exchange specimens, literature, and experiences. Jurgen Otto, 4006 Erkrath Kirchstr. 36—West Germany.

PUERTO RICAN COLEOPTERA: Building reference collection; need determiners (can keep duplicates). Will also exchange. Julio Micheli, 14 Baldorioty St., Mariani, Ponce, Puerto Rico 00731.

LUCANIDAE: Buy, sell, exchange all species. Also want collection data and world literature on the family. Bill E. Gavin, 981 N. W. Circle Blvd. #1, Corvallis, OR 97330.

CARABIDAE: Have *Calosoma (Carabominus) asper* Jeannel & *C. (Blapstoma) chihuahua* Gidaspow for exchange. I want *Carabus*, Cychrini, or *Calosoma* not represented in my collection. B. Rotger, Pagosa Springs, Colo. 81147.

RHYSODIDAE: Wanted, for world-wide revision. Willing to identify and return or exchange for U. S. Carabidae. Ross T. Bell, Zoology Dept., University of Vermont, Burlington, VT 05401, U.S.A.

SCARABAEIDAE: Working toward a general revision of the Anomalinae of Mexico, Central, and South America. Specimens and records needed by loan, purchase, or exchange. Identifications by arrangement. Robert W. L. Potts, California Acad. Sci., Golden Gate Park, San Francisco, CA 94118.

CHRYSOMELIDAE (ALTICINAE): Reworking manuscript revision of the maculate species of *Phyllotreta* of the U. S. and Canada for publication (includes the normally immaculate *P. denticornis, P. decipiens*, and *P. d. ordinata*). Request loan of such material immediately. Eric H. Smith, Division of Insects, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

MELOIDAE: Revising the genus *Gnathium* (Nemognathinae). Request loan of specimens from all areas, Mexican material being particularly welcome. Wilbur R. Enns, 1-87 Agriculture Building, University of Mo., Columbia, MO 65201.

DETERMINATIONS DESIRED: Blacklight trap operated year-round in Puerto Rico. Advise your interest, and if it appears I will send it to you in 70% alcohol in return for mounting and ID. You keep duplicates. H. L. Murphy, Calle 21 Sur #0-1, Bayamon Gardens, Bayamon, PR 00620.

SCARABAEIDAE: For sale or trade—specimens of *Goliathus cacicus, G. regius*, and occasionally *G. atlas* and *G. albosignatus*; wanted—other African Cetoniinae and Lucanidae. Write for prices and specific desiderata. Chris Adamson, 2437 Warring #G, Berkeley, CA 94704.

PEDILIDAE: Revising North American species of *Pedilus*. Request loan of determined and/or undetermined larvae and adults from any area. Also interested in bionomics of group, correspondence welcome. Daniel K. Young, Dept. Ent., Michigan State Univ., East Lansing, MI 48824.

CICINDELINAE CATALOGUE WANTED: Coleopterorum Catalogus #86, W. Horn, 1926. H. Boyd, Oak Shade Rd., Tabernacle Twp., RD 4, Vincentown, NJ 08088.

CERAMBYCIDAE: Need *Derancistrus* spp. from all areas for study. Will buy or exchange. Julio Micheli, 14 Baldorioty Str., Mariani, Ponce, PR 00731.

AVAILABLE FREE: Werner, Enns, Parker, "The Meloidae of Arizona", TB 175 (1966) and Butler & Werner, "Distrib. and Host Plants of May Beetles in Arizona", TB 147 (1961). Floyd G. Werner, Dept. Ent., Univ. Arizona, Tucson, AZ 85721.

FOR SALE: First class well preserved colorful insects and butterflies, many hundreds of species and subspecies. Small or big order accepted; will send by air mail to your home. Peter Andersen, Global Colosseum, 67 Spottiswoode Park Rd., Spore 2, SINGAPORE.

EXCHANGE: Wanted—North and Central American Dytiscidae, Gyrinidae, Dryopidae, Elmidae, Heteroceridae, Haliplidae. Offered—species from Central Europe. Witold Wiezlak, 04-607 Warszawa, Trawiasta 29 b, POLAND.

FOR SALE: Melolonthinae—very rare *Euchirus dupontianus* at $150/pair, postpaid airmail. Assorted Asian Coleoptera $100/box. Mrs. Zenaida Jardiniano, Nepomuceno Street, Boac, Marinduque 3801, PHILIPPINES.

PSEPHENIDAE (PSEPHENINAE, EUBRIINAE, EUBRIANACINAE, PSEPHENOIDINAE): Revising for world. Request loan of specimens from all areas. Harley P. Brown, Zoology Dept., Univ. Oklahoma, Norman, OK 73019.

v.31
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THE COLEOPTERISTS BULLETIN

AN INTERNATIONAL JOURNAL DEVOTED TO THE STUDY OF BEETLES

Volume 31, No. 3 **September, 1977**

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THE COLEOPTERISTS BULLETIN

(Founded 1947 by Ross H. Arnett, Jr.)

The **Coleopterists Bulletin** is published quarterly, beginning in March, by the Coleopterists Society. Send all manuscript articles, editorial questions, subscription inquiries, and address changes to the *Bulletin editor*: Dr. Donald R. Whitehead, c/o Dept. Entomology, Stop 168, Smithsonian Institution, Washington, DC 20560. Send requests for missing issues to the *managing editor*: Dr. Robert E. Woodruff, Florida Dept. Agr., P. O. Box 1269, Gainesville, FL 32601. Send material for literature review to the *review editor*: Dr. Paul P. Shubeck, Dept. Biology, Montclair State College, Upper Montclair, NJ 07043. *Associate editor*: Dr. Robert D. Gordon, Syst. Ent. Lab., USDA, ARS, c/o U.S. National Museum, Washington, DC 20560.

Starting in 1977, a revived **Coleopterists Newsletter** appears in the Bulletin when warranted by sufficient material. Send all news items, collecting notes, and similar material to the *Newsletter editor*: Dr. Charles W. O'Brien, Lab. of Aquatic Ent., Univ. P. O. Box 111, Florida A&M Univ., Tallahassee, FL 32307.

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(*Continued inside back cover*)

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CLASSIFICATION AND PHYLOGENY OF THE NEW WORLD STICHOLOTIDINAE (COCCINELLIDAE)

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Abstract

The subfamily Sticholotidinae of the Western Hemisphere is taxonomically treated. The tribes Sukunahikonini, Microweisini, Serangiini, and Sticholotidini are recognized; 5 new genera (*Microcapillata, Sarapidus, Nesina, Neotina, Glomerella*) are described; 16 new species in various genera are described. The tribe Sukunahikonini is recorded for the first time from the New World. The phylogenies of the subfamily and each tribe are discussed, and a discussion of zoogeography of the subfamily is included.

The atypical characteristics of certain genera of Coccinellidae, currently placed in the subfamily Sticholotidinae, were first noted by Weise (1887). Weise tentatively proposed the family-group name Pseudococcinellidae for 3 of these Old World genera, *Coelopterus* Mulsant, *Pharus* Mulsant, and *Sticholotis* Crotch. Sicard (1909) perpetuated the use of this name and added the genera *Serangium* Blackburn and *Habrolotis* Weise. Unfortunately, the family-group name Pseudococcinellidae is not available because there is no genus *Pseudococcinella* on which it can be based. Casey (1899) erected the tribe Pharini to include *Pharus* and *Pharopsis* Casey. This tribal name was used by Korschefsky (1931) and remained the name in common usage until 1967. Pope (1962) reviewed the genera of Pharini on a world basis and included the first key to genera. Weise (1901) proposed the tribe Sticholotini. Sasaji (1967, 1968) proposed the subfamily Sticholotinae and indicated that the Sticholotini corresponded to the Pharini as used by Pope (1962). Sasaji pointed out that the generic name *Pharus* Mulsant was preoccupied by *Pharus* Gray (1840) and had been replaced by *Pharoscymnus* Bedel, thus making the name Pharini unavailable. The tribal name Microweisini was proposed by Leng (1920) for the New World genus *Microweisea.* The tribal name Serangiini first appeared in Blackwelder's checklist (1945) and has been accepted by all subsequent authors.

This paper is an attempt to classify the New World genera and tribes of the Sticholotidinae. In previous papers (Gordon 1969, 1970a, 1970b, 1970c, 1970d) individual genera and species have been treated but no complete classification has been proposed.

Acknowledgments

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bridge (MCZ); H. Freude, Zoologische Sammlung des Bayerischen Staates, Munich, Germany (ZSBS); United States National Museum, Washington, D.C. (USNM). Douglass R. Miller, U.S. Department of Agriculture, Systematic Entomology Laboratory, Beltsville, Maryland, provided names for the hosts listed, and A. D. Cushman made the illustrations presented herein. I especially thank Donald R. Whitehead for advice and encouragement given me during the preparation of the section on phylogeny.

Sticholotidinae, **emendation**

Sticholotinae: Weise 1901:430.—Sasaji 1967:2.—Sasaji 1968:19.

Small to medium-sized Coccinellidae; hemispherical or elliptical; functional wings present or absent; dorsally pubescent or not. Head with apical segment of maxillary palpus more or less tapered, conical, barrel shaped or elongate oval; mentum and submentum narrowly joined; antenna with 7 to 11 segments, club composed of 1 to 5 segments. Pronotum sometimes with line or ridge separating anterior angle from disc. Metendosternum with very broadly separated anterior tendon. Abdomen with 5 or 6 visible sterna; male 9th sternum flat. Tarsus 3-segmented or cryptotetramerous. Female genital plate elongate, triangular.

The subfamily is principally characterized by the form of the terminal segment of the maxillary palpus which is not securiform or distinctly broadened apically as is typical of the rest of the Coccinellidae. The form of the maxillary palpus is an excellent distinguishing character for members of the Serangiini, Sukunahikonini, and Microweisini, but some genera in the Sticholotidini have that segment more or less enlarged, approaching the typical coccinellid type.

Members of this subfamily are found throughout the tropical regions of the world with some genera and species occurring also in temperate regions. None of the genera included in the subfamily (except *Sticholotis*) contain very many species, and many are monobasic.

Sasaji (1968) discussed the relationships of the Sticholotidinae quite thoroughly and I agree with his conclusions in most respects. He did not have examples of such genera as *Microweisea* or *Scotoscymnus* to examine, but in spite of this, his classification is basically sound because these and other genera fit that classification with very little adjustment.

The phyletic lineages have not previously been accurately delimited. I have accepted the Sukunahikonini and Serangiini as monophyletic and also consider a third tribe, Microweisini, as a monophyletic element. The fourth tribe, Sticholotidini, remains in a chaotic state and will ultimately have to be split into additional tribes. I have not attempted this here because nearly all of the genera are Old World, and all must be studied in detail.

The following changes in, and additions to, the New World fauna are proposed herein: the tribe Sukunahikonini is recorded from the New World for the first time, and 9 new species are described; the tribe Microweisini is revived and 7 genera in addition to *Microweisea* placed in it, and 2 new genera and 2 new species are described; and 3 new genera and 5 new species are described in the tribe Sticholotidini.

NEW WORLD TAXA OF STICHOLOTIDINAE

Tribe SUKUNAHIKONINI

Genus *Scotoscymnus* Weise
    S. pygmaeus, n. sp.
    S. elongatus, n. sp.
    S. apterus, n. sp.
    S. facetus, n. sp.
    S. globosus, n. sp.
    S. orchidion, n. sp.
    S. stephensi, n. sp.
    S. perpusillus, n. sp.
    S. colombianus, n. sp.

Tribe MICROWEISINI

Genus *Microcapillata,* n. gen.
    M. clypealis, n. sp.
Genus *Sarapidus,* n. gen.
    S. australis, n. sp.
Genus *Stictospilus* Brèthes
    S. darwini Brèthes
Genus *Microweisea* Cockerell
    M. suturalis (Schwarz)
    M. minuta (Casey)
    M. misella (LeConte)
    M. coccidivora (Ashmead)
    M. ovalis (LeConte)
Genus *Coccidophilus* Brèthes
    C. citricola Brèthes
    C. atronitens (Casey)
    C. marginata (LeConte)
    C. peninsularis (Gordon)
Genus *Pseudosmilia* Brèthes
    P. arrowi Brèthes
Genus *Gnathoweisea* Gordon
    G. schwarzi Gordon
    G. planiceps (Casey)
Genus *Nipus* Casey
    N. biplagiatus Casey
    N. niger Casey
    N. planatus Gordon
    N. occiduus Gordon

Tribe SERANGIINI

Genus *Catana* Chapin
    C. clauseni Chapin
Genus *Delphastus* Casey
    D. nebulosus Chapin
    D. pallidus (LeConte)
    D. collaris Chapin
    D. minutus Gordon
    D. abditus Gordon
    D. dubitalis Gordon
    D. anthracinus Gordon
    D. chapini Gordon
    D. catalinae (Horn)
    D. diversipes (Champion)
    D. pusillus (LeConte)
    D. argentinicus Nunenmacher

Tribe STICHOLOTIDINI

Genus *Nexophallus* Gordon
    N. rufoglobus Gordon
    N. semiglobus Gordon
    N. lindemanni, n. sp.
Genus *Nesina,* n. gen.
    N. amazonia, n. sp.
Genus *Neotina,* n. gen.
    N. cariba, n. sp.
Genus *Glomerella,* n. gen.
    G. perconvexa, n. sp.
    G. gnoma, n. sp.

KEY TO TRIBES OF NEW WORLD STICHOLOTIDINAE

1. Antennal club of a single knife-shaped or elongate-oval segment (fig. 78); femora broad, flat, fitting into depressions on ventral surface; prosternum greatly expanded in front to conceal mouthparts (fig. 77) .... Serangiini

1′. Antennal club composed of more than a single segment or if so, then segment not knife shaped; femora not broad, flat, ventral surface with or without depressions for legs; prosternum not greatly expanded, not concealing mouthparts 2

2(1′). Pronotum with oblique line separating the anterior angle from disc (fig. 61); abdomen with 6 visible sterna 3

2′. Pronotum without oblique line; abdomen with 5 visible sterna .... Sticholotidini

3(2). Dorsal surface with dense pubescence composed of intermixed long and short hairs (fig. 4); prosternal process extremely slender (fig. 10), prosternum not lobed anteriorly .... Sukunahikonini

3′. Dorsal surface usually glabrous, if pubescent, then pubescence of uniform length; prosternal process broad, T-shaped (fig. 62), prosternum lobed anteriorly .... Microweisini

TRIBE SUKUNAHIKONINI

Sukunahikonini: Kamiya 1960:24.—Sasaji 1967:4.—Sasaji 1968:20.

Small Sticholotidinae with dense dorsal pubescence, pubescence usually composed of intermixed long, mostly erect hairs and shorter, semi-erect hairs. Head capsule with prolonged frons, and clypeus emarginate around antennal insertion; eye small, coarsely faceted; mandible without apical or basal teeth; apical segment of maxillary palpus slender, tapered to apex; antenna either 9-segmented or 10-segmented, club with 1 or 2 segments (figs. 7, 8). Front coxae narrowly separated by slender intercoxal process; prosternum not lobed anteriorly (fig. 10). Leg simple, tibia unmodified. Functional wings present or absent. Abdomen with 6 visible sterna.

The prosternal structure of members of this tribe is, as pointed out by Kamiya (1960), unique within the family. The obvious dorsal pubescence, absence of functional wings (in some instances), and cryptotetramerous tarsi are other characteristics separating this tribe from the Microweisini to which it is most closely related. Two genera of Microweisini possess cryptotetramerous tarsi, but the other genera all have the trimerous condition.

The tribe Sukunahikonini was erected by Kamiya (1960) for a single genus from Japan and Formosa. He later placed a second Formosan genus in it. Chapin (1965) described 8 species from Micronesia in *Pharellus* Sicard without commenting on the affinities of that genus. Pope (1962) included all of the genera here considered to belong in the Sukunahikonini in his review of the Pharini. Because representatives of these genera are rarely collected, type material is often needed in order to examine a genus or species. Thus, genera have been described by several authors, or at least utilized by them, without their being aware that related or synonymous genera were in existence. In the course of determining the affinities of the group of species here treated as members of the genus *Scotoscymnus* Weise, I have examined representatives of all the Old World genera known to resemble that genus. As a result, I transfer the following genera from Sticholotidini to Sukunahikonini: *Orculus* Sicard (West Africa), and *Scotoscymnus* Weise (equals *Pharellus* Sicard) (pantropical). With the Japanese and Formosan genera *Sukunahikona* and *Hikonasukuna*, there are presently 4 genera in the Sukunahikonini.

The species of *Scotoscymnus* described herein represent the first records of this tribe from the New World. Accurate host records are not available for these species, the available data consisting of such items as "banana scale", "on coconut", or "on orchids". Chapin (1965) lists "*Aspidiotus* sp., on coconut" and "on coconut infested with Furcaspis sp." from Micronesia. Specimens in the USNM collection from Mauritius are labeled "Predator of *Aulacaspis (Pseudaulacaspis) pentagona*" and "on *Furcaspis charmoyi* Brain". Kamiya (1966) has recorded *Sukunahikona japonica* Kamiya as preying on *Aulacaspis difficilis* (Cockerell) in Japan and *Sukunahikona bicolor* Kamiya preying on "Disapididae sp. on citrus", also in Japan. It would seem that the scale genera *Furcaspis* and *Aspidiotus* are preferred hosts for *Scotoscymnus* spp. Both of these genera could occur on orchids, and *Aspidiotus destructor* Signoret is a pest on coconut, and banana. Thus, host preferences of members of this genus obviously are with the family Diaspididae (Armored Scales). According to Beardley and Gonzalez, 1975, armored scales occur anywhere vascular plants are found, but the greatest numbers and diversity of genera and species are tropical. Further information on the zoogeography of diaspidid scales has not been published, but would not be extremely useful anyway because definitive host data are not available for most species of *Scotoscymnus*.

Genus *Scotoscymnus* Weise

Scotoscymnus Weise 1901:458.—Pope 1962:628. Type-species; *Scymnomorphus rotundatus* Weise, by subsequent designation of Pope 1962 (replacement name).

Scymnomorphus Weise 1897:303 (not Blackburn 1892).—Weise 1901:458.

Pharellus Sicard 1928:300.—Chapin 1965:228.—Gordon 1970e:217. Type-species; *Pharellus minutissimus* Sicard, by monotypy. **New synonymy**.

Sukunahikonini with form oval, slightly elongate; dorsum pubescent (fig. 1). Antenna 9 or 10-segmented, club with 1 or 2 segments (figs. 7, 8); apical segment of maxillary palpus elongate, conical (fig. 9). Elytron with lateral margin slightly flared or with distinct, flat ridge (figs. 12, 13). Functional wings and humeral callus present or absent. Abdomen with postcoxal lines divided and pits present or absent (figs. 16, 22); suture between first and second sterna incomplete, sterna fused (fig. 20). Tarsi cryptotetramerous (fig. 14). Male genitalia asymmetrical, parameres greatly reduced or absent (fig. 31).

I have examined specimens of *Scotoscymnus* from Mauritius, "*Pharellus*" from Micronesia, and 9 previously undescribed New World species from Mexico, Central and South America. I can find no valid reasons for erecting or maintaining more than one genus for the species involved and so place *Pharellus* Sicard as a junior synonym of *Scotoscymnus* Weise. It is also possible that *Sukunahikona* Kamiya is congeneric with *Scotoscymnus* and may have to be placed in synonymy at some future time.

The most reliable characters for separation of the New World species of *Scotoscymnus* are the male and female genitalia and the pores, pits, and postcoxal lines on the abdomen. The genitalia require dissection, and, with the exception of *S. elongatus* and *S. globosus*, the species usually cannot be accurately identified without dissection.

The presence of both 9 and 10-segmented antennae in the same genus of Coccinellidae is unusual and would seem to indicate the possibility of more than one genus being present. However, I can find no other supporting reasons for establishing another genus and have not done so. The wingless condition is also unusual in this family, but 4 of the 9 New World species lack functional wings. Except in *S. pygmaeus,* the cryptotetramerous condition of the tarsi is difficult to detect because the third tarsal segment is so minute that it can be seen only under extremely high magnification. The species *S. elongatus, S. apterus, S. facetus,* and *S. globosus* all lack functional wings, possess 9-segmented antennae (club with a single segment), and lack pits on the first abdominal sternum. The species *S. colombianus, S. perpusillus, S. stephensi,* and *S. pygmaeus* have functional wings, possess 10-segmented antennae (club with 2 segments), and have pits on the first abdominal sternum. *S. orchidion* does not fit in either group because it has the 9-segmented antennae of the first group but also possesses the functional wings of the second group while the first abdominal sternum lacks pits.

Most of the specimens of *Scotoscymnus* available for study were collected by USDA Plant Protection Inspectors at various Quarantine stations. Consequently the locality data often consists of "intercepted Brownsville, Texas, ex. Mante, San Luis Potosi, Mexico", etc. This is obviously less than desirable data but unfortunately all that is available for some species.

The type series (2 specimens) of *Pharellus minutissimus* Sicard is in the collection of the British Museum (NH). I have examined the series and here designate and label the first one lectotype, the second specimen paralectotype. The specimens are labeled "syntype/type/predator on Chrysomphalus/T. Java 1926 T. H. C. Taylor/Pres. by Imp. Bur. Ent. Brit. Mus. 1927-439/Pharellus n.g. minutissimus Sic n.-sp. type".

KEY TO NEW WORLD SPECIES OF *Scotoscymnus*

1. Antennal club with one segment (fig. 8) 2

1′. Antennal club with 2 segments (fig. 7) 6

2(1). Form extremely elongate, dorsoventrally flattened (fig. 2); elytral punctures coarse deep, dense .... *S. elongatus*, n. sp.

2′. Form oval or rounded, usually somewhat elongate, not flattened 3

3(2′). Form rounded (fig. 4); postcoxal line toothed (fig. 19) .... *S. globosus*, n. sp.

3′. Form oval, somewhat elongate; postcoxal line not toothed except *orchidion*) 4

4(3′). Humeral callus present (fig. 6); functional wings present .... *S. orchidion*, n. sp.

4′. Humeral callus lacking (fig. 2); functional wings absent 5

5(4′). Second abdominal sterna with large seta-bearing pores (fig. 18) .... *S. facetus*, n. sp.
5′. Second abdominal sterna with very fine, indistinct punctures (fig. 17) .... *S. apterus*, n. sp.
6(1′). Lateral margin of elytron slightly flared, not thickened or ridged (fig. 12) .... *S. pygmaeus*, n. sp.
6′. Lateral margin of elytron thickened, expanded into a flat ridge (fig. 13) 7
7(6′). First abdominal sternum with inner postcoxal line extending anteriorly from pit, outer postcoxal line long, straight (fig. 21) .... *S. stephensi*, n. sp.
7′. First abdominal sternum with inner postcoxal line terminated at pit, outer postcoxal line short, curved (fig. 22) 8
8(7′). Lateral ridge on elytron flat, without distinct, deep groove between ridge and disc of elytron .... *S. perpusillus*, n. sp.
8′. Lateral ridge on elytron obliquely inclined, with distinct, deep groove between ridge and disc of elytron .... *S. colombianus*, n. sp.

Scotoscymnus pygmaeus Gordon, **new species**

Holotype.—Female, length 1.0 mm, greatest width 0.63 mm. Form oval, somewhat elongate (fig. 1), convex. Dark reddish brown; pronotum slightly paler, head yellowish brown; mouthparts, antennae, and legs yellow; apex of abdomen yellowish brown. Head shiny, coarsely punctured, punctures separated by a diameter or less. Pronotum smooth, polished, coarsely punctured, punctures separated by less than to twice a diameter; anterolateral line separated from anterolateral angle by width of basal antennal segment, joining lateral border. Elytron somewhat dull, alutaceous, punctures subequal in size to pronotal punctures, separated by a diameter or less; pubescence composed of more or less uniform, semi-erect hairs; lateral border feebly thickened, groove between border and disc shallow. Functional wing and humeral callus present. Third tarsal segment large, distinctly visible. Ventral surface smooth, polished, with some sparse pubescence becoming dense on last 2 abdominal sterna. Postcoxal line as in fig. 15. Genitalia with spermathecal capsule composed of a large, round, basal area and 2 smaller round areas (fig. 23).

Allotype.—Male, similar to holotype except for sexual characters. Genitalia with basal lobe curved, parameres extremely reduced (fig. 29); sipho short, feebly curved, bent before apex (fig. 30).

Type-material.—Holotype, La Ceiba, Honduras, March 21-20 (1920), W. M. Mann, on coconut (USNM 73765). Allotype, same data as holotype except date Feb. 29, 1920 (USNM). Paratypes, 4, same data as holotype except dates Feb. 29, 1920 and Mar. 3, 1920 (USNM).

Variation.—Length and width are the same in all specimens examined, but some are paler in color which is apparently a function of teneral condition.

Remarks.—The relatively close, even elytral punctation, uniform elytral pubescence, and lack of a pronounced lateral ridge on the elytron separate *S. pygmaeus* from the other winged species of *Scotoscymnus*. In addition, the relatively large third tarsal segment is unique to this species. The specific name is a Latin adjective meaning dwarfed or pygmy.

Scotoscymnus elongatus Gordon, **new species**

Holotype.—Female, length 1.20 mm., greatest width 0.60 mm. Form elongate, slender, flattened (fig. 2). Dark reddish brown; head yellowish brown; mouthparts, antennae, and legs yellow; apex of abdomen yellowish brown. Head feebly shiny, surface alutaceous, coarse, indistinct punctures present, separated by a diameter or less. Pronotum apparently impunctate, finely alutaceous; anterolateral line very close to anterolateral angle, joining lateral border at midpoint. Elytron shiny, densely, coarsely punctured, punctures separated by 1/2 a diameter or less; pubescence uniform in length, composed of long, semi-erect hairs; lateral border thickened, forming a flat, wide ridge with deep groove between ridge and disc of elytron. Functional wing and humeral callus absent. Prosternum slightly expanded anteriorly (fig. 10). Ventral surface smooth, polished, with some sparse pubescence becoming dense on last 2 abdominal sterna. Postcoxal line as in fig. 16. Genitalia with spermathecal capsule as in fig. 24.

Allotype.—Male, similar to holotype except length 1.0 mm., width 0.55 mm. Genitalia with basal lobe flattened laterally, parameres very short (fig. 31); sipho as in fig. 32 (broken).

Type-material.—Holotype, intercepted Brownsville, Texas, ex. Mante, San Luis Potosi, Mexico, 29-III-1965, on orchid plants (USNM 73757). Allotype and 1 paratype, same data as holotype (USNM).

Variation.—The length and width vary as indicated for the holotype and allotype. The allotype is a light yellowish brown in color but this is because it is not a fully hardened specimen.

Remarks.—This is the most easily recognized member of the genus because of the extremely coarse elytral punctures and elongate form. In addition, the prosternum is slightly expanded anteriorly (fig. 10). The specific name is a Latin adjective referring to the elongate body form.

Scotoscymnus apterus Gordon, **new species**

Holotype.—Male, length approximately 1.0 mm. This specimen was completely dissected by E. A. Chapin and the parts mounted on a permanent slide. Because of this no accurate measurement of length or width can be made. Description as for *S. orchidion* except pronotum with extremely fine, nearly invisible punctures; functional wing and humeral callus absent. Postcoxal line as in fig. 17. Male genitalia with basal lobe long, laterally compressed (fig. 33); sipho slightly sinuate before apex, tip broken (fig. 34); *spiculum gastrale* large, robust (fig. 35).

Type-material.—Holotype, intercepted at Laredo, Texas, ex. San Luis Potosi, Mexico, Oct. 27, 1955, Watt collector, on orchids (USNM 73758).

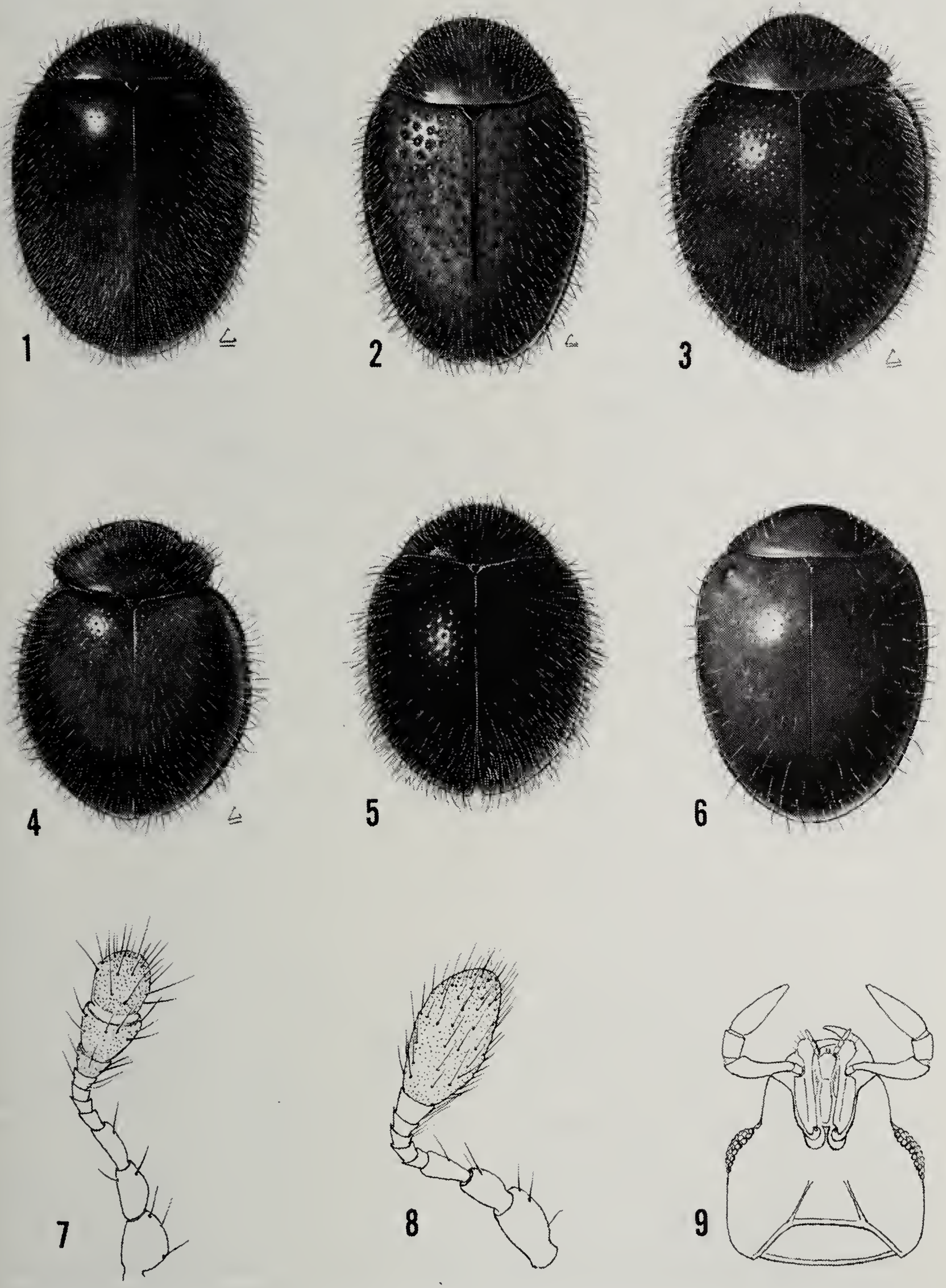
Remarks.—The unique male type is completely dissected as indicated above. As a result, it is difficult to compare this species with others represented by whole specimens. There do not appear to be any significant external differences between *S. apterus* and *S. orchidion* except that *S. apterus* lacks functional wings. The male genitalia are distinctive for each species. The specific name is a Latin adjective referring to the wingless condition.

Scotoscymnus facetus Gordon, **new species**

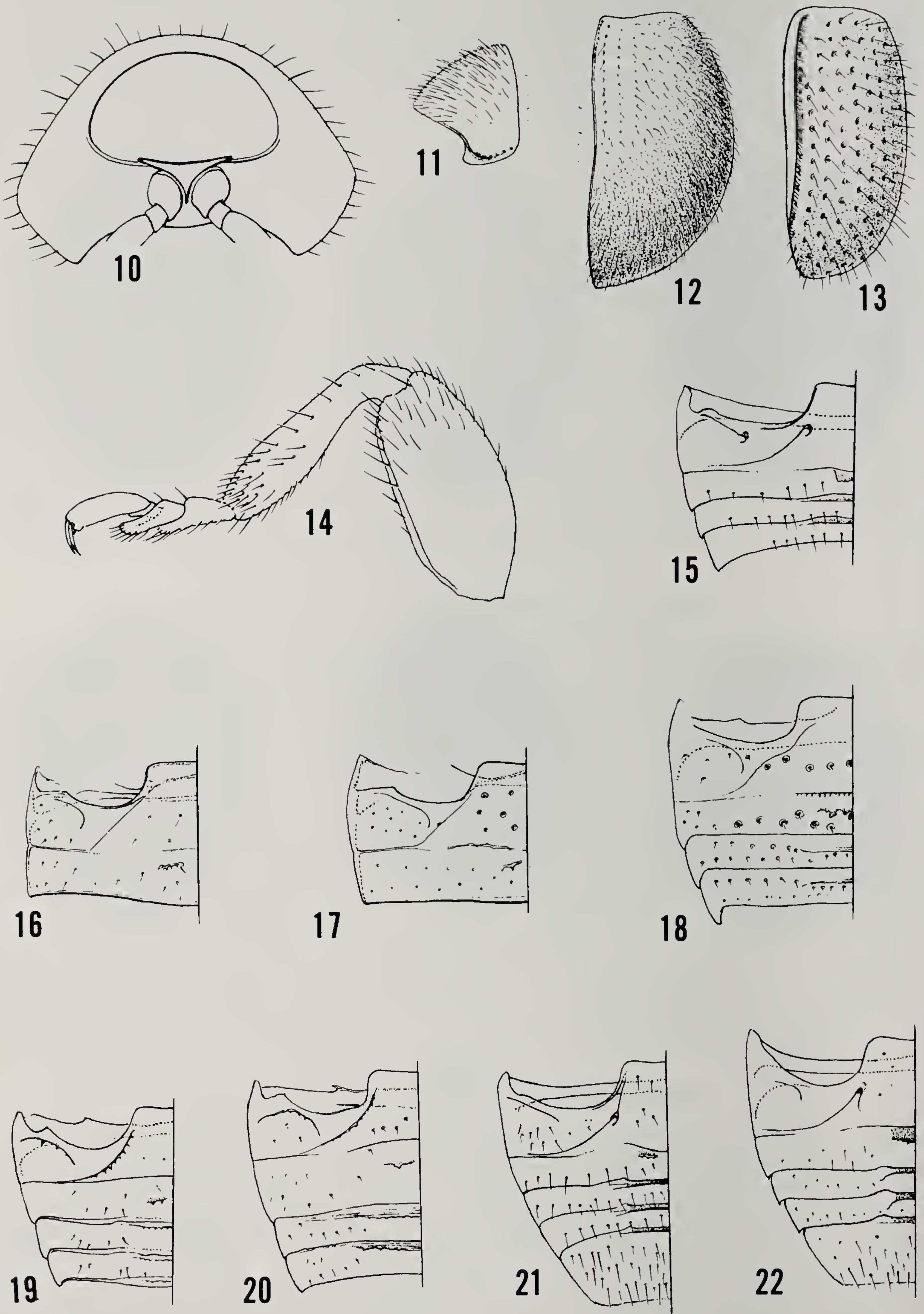
Holotype.—Female, length 1.05 mm, greatest width 0.63 mm. Form oval, somewhat elongate (fig. 3), convex. Dark reddish brown; head and pronotum yellowish red; mouthparts, antennae, and legs yellow; apex of abdomen yellowish brown. Head shiny, coarsely punctured, punctures separated by less than to twice a diameter. Pronotum polished, very finely punctured, punctures separated by 3 to 5 times a diameter; anterolateral line very close to anterolateral angle, joining lateral border. Elytron densely, coarsely punctured, punctures separated by their diameter or less; pubescence composed of short, erect hairs and interspersed, long, semierect hairs; lateral border thickened, forming a flat, wide ridge with deep groove between ridge and disc of elytron. Functional wing and humeral callus absent. Ventral surface smooth, polished, with few fine punctures, and sparse pubescence becoming dense on last abdominal sternum. Postcoxal as in fig. 18. Genitalia with spermathecal capsule as in fig. 26.

Type-material.—Holotype, Mexico, San Luis Potosi, Tamazunchale, May 4, 1958, on Philodendron (USNM 73759).

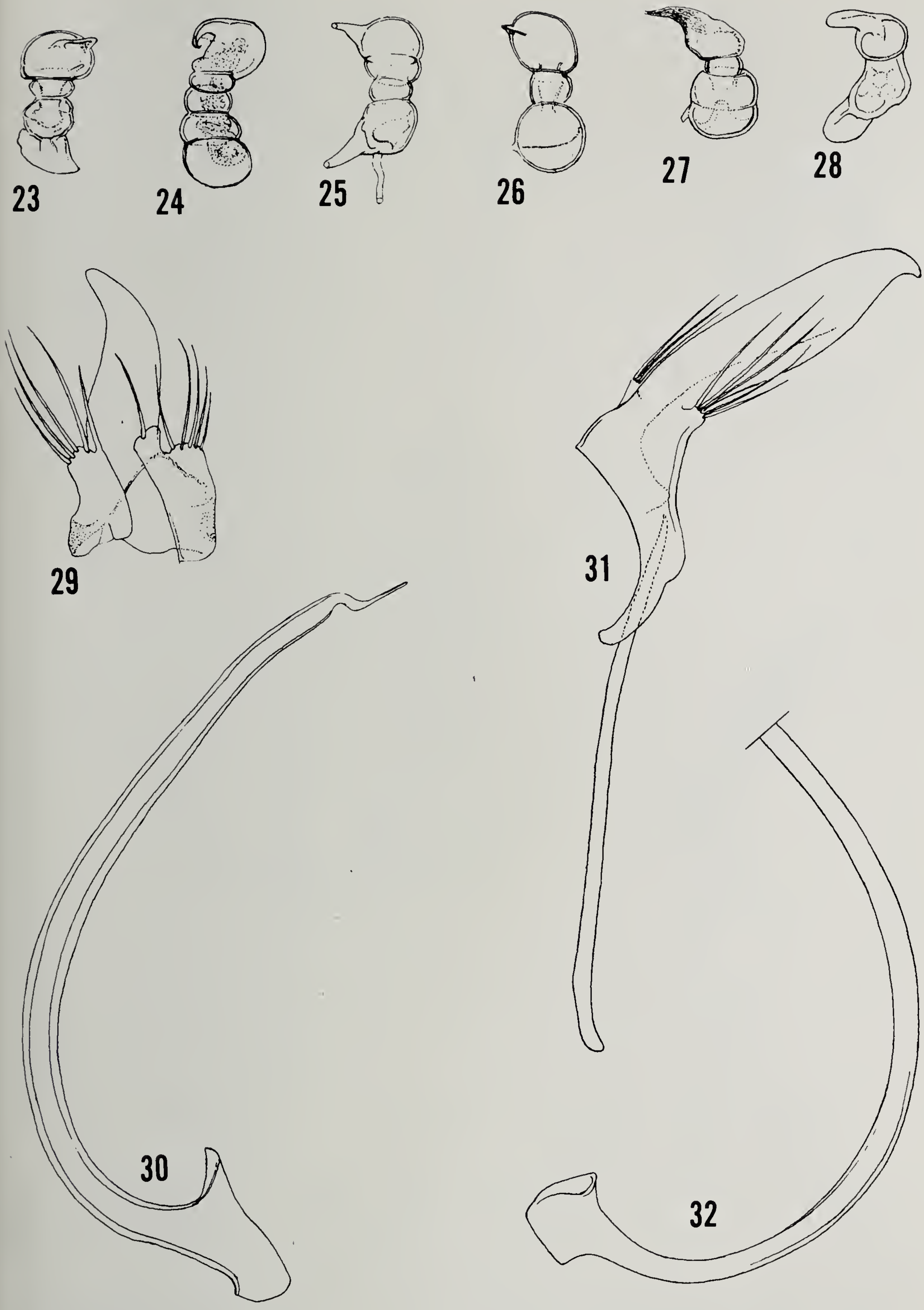
Remarks.—The coarse, dense elytral punctures are characteristic, resembling only *S. elongatus* in this respect. In addition, the very wide lateral elytral ridge and polished, nearly impunctate pronotum are characters shared only by *S. stephensi.* The sinuate inner postcoxal line is unlike that possessed by any described species. The specific name is a Latin adjective meaning fine, well made.



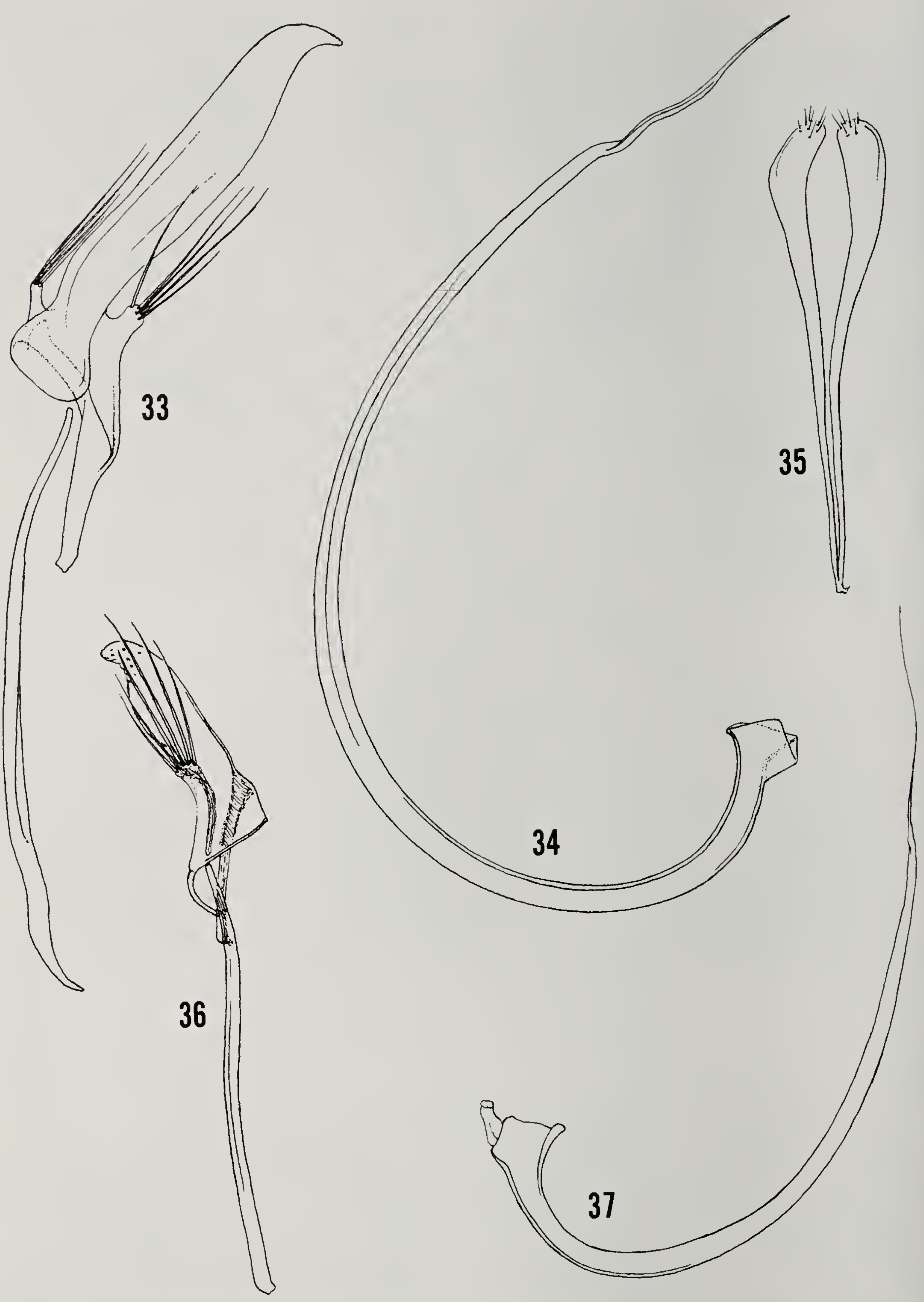
Figs. 1-9, *Scotoscymnus* species. figs. 1-6, habitus views: 1, *pygmaeus*; 2, *elongatus*; 3, *facetus*; 4, *globosus*; 5, *stephensi*; 6, *colombianus*. Figs. 7-9: 7, antenna, *pygmaeus*; 8, antenna, *elongatus*; 9, ventral view of head, *apterus.*



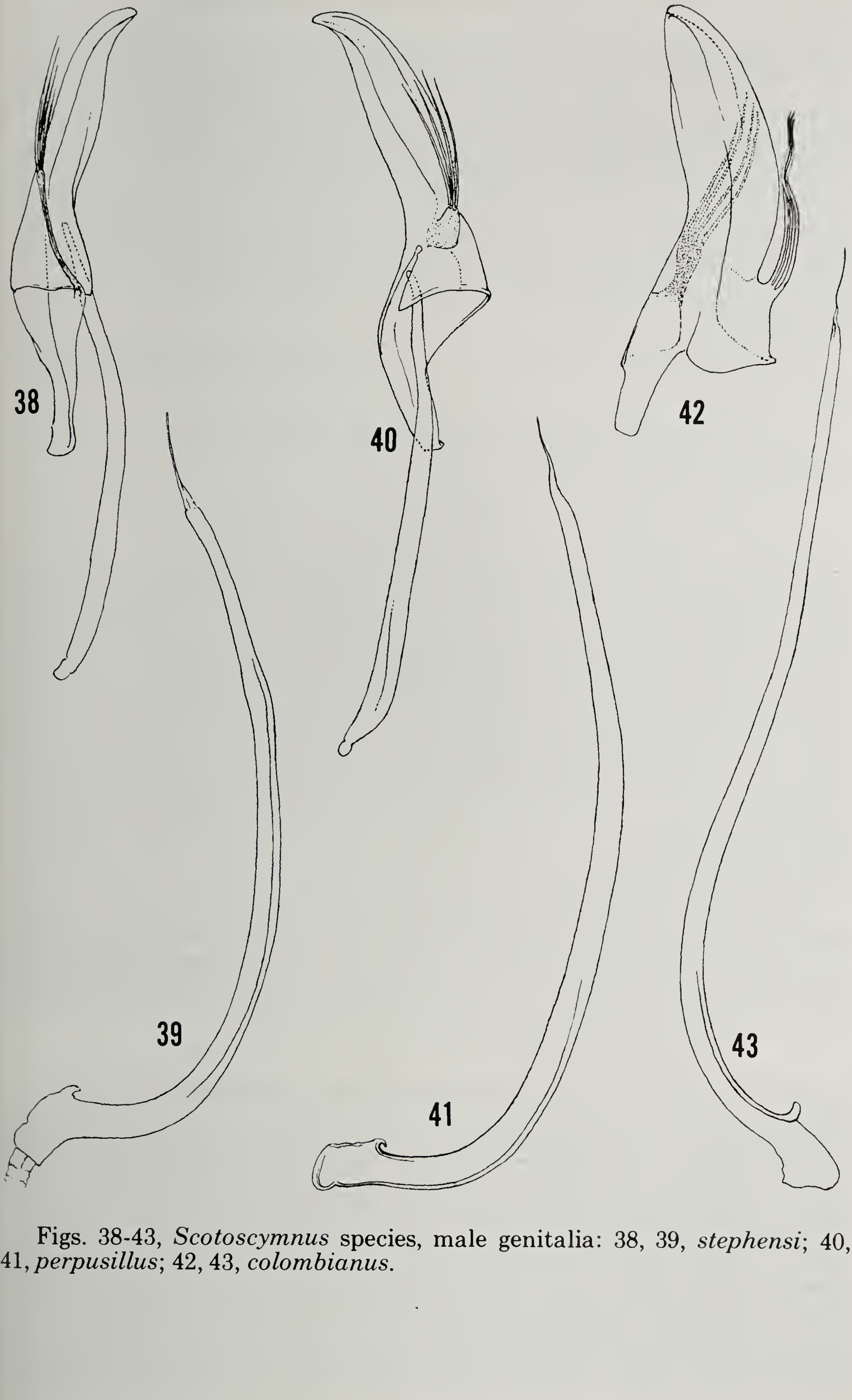
Figs. 10-22, *Scotoscymnus* species. Figs. 10-14: 10, prosternum, *elongatus*; 11, lateral view of pronotum, *pygmaeus*; 12, lateral view of elytron, *pygmaeus*; 13, lateral view of elytron, *elongatus*; 14, anterior leg, *elongatus*. Figs. 15-22, abdomens: 15, *pygmaeus*; 16, *elongatus*; 17, *apterus*; 18, *facetus*; 19, *globosus*; 20, *orchidion*; 21, *stephensi*, 22, *colombianus*.



Figs. 23-32, *Scotoscymnus* species. Figs. 23-28, spermathecae: 23, *pygmaeus*; 24, *elongatus*; 25, *globosus*; 26, *facetus*; 27, *stephensi*; 28, *colombianus*. Figs. 29-32, male genitalia; 29, 30, *pygmaeus*; 31, 32, *elongatus*.



Figs. 33-37. *Scotoscymnus* species, male genitalia: 33-35, *apterus*; 36, 37, *orchidion*.



Figs. 38-43, *Scotoscymnus* species, male genitalia: 38, 39, *stephensi*; 40, 41, *perpusillus*; 42, 43, *colombianus*.

Scotoscymnus globosus Gordon, **new species**

Holotype.—Female, length 0.82 mm, greatest width 0.66 mm. Form rounded (fig. 4), convex. Dark reddish brown: pronotum and head slightly paler; mouthparts, antennae and legs yellow; ventral surface yellowish brown. Head shiny, with moderately coarse punctures, punctures sparse, irregularly scattered. Pronotum shiny, finely punctured, punctures separated by 1 to 4 times a diameter; anterolateral line extremely close to anterolateraal angle, barely distinct from it, joining lateral border in apical 1/5. Elytron slightly alutaceous, punctures coarser than on head, separated by less than to twice a diameter; pubescence composed of intermixed long and short, erect hairs; lateral border moderately thickened, groove between border and disc shallow. Functional wing and humeral callus absent. Ventral surface smooth, polished, with some sparse pubescence becoming dense on last 2 abdominal sterna. Postcoxal line as in fig. 19. Genitalia with spermathecal capsule as in fig. 25.

Type-material.—Holotype, intercepted Laredo, Texas, ex. Mexico, 19-II-1970 (USNM 73760).

Remarks.—With the exception of *S. elongatus, S. globosus* is the most easily recognized of the New World species. The short, round form is characteristic, and the presence of toothed postcoxal lines (fig. 19) is similar only to that condition in *S. orchidion.* The specific name is a Latin adjective referring to the rounded body form.

Scotoscymnus orchidion Gordon, **new species**

Holotype.—Male, length 0.90 mm, greatest width 0.71 mm. Form oval, somewhat elongate, convex. Color dark reddish brown; head yellowish brown; mouthparts, antennae, and legs yellow; apex of abdomen yellowish brown. Head shiny, faintly alutaceous, punctures coarse, indistinct, separated by less than to twice a diameter. Pronotum faintly alutaceous, finely punctured, punctures separated by 2 to 4 times a diameter; anterolateral line widely separated from anterolateral angle. Elytron alutaceous, punctures coarser than on head, separated by a diameter or less; pubescence composed of intermixed long and short, semi-erect hairs; lateral border feebly thickened, groove between border and disc shallow. Functional wing and humeral callus present. Ventral surface smooth, polished, with some sparse pubescence becoming dense on last 2 abdominal sterna. Postcoxal line as in fig. 20. Genitalia with basal lobe thickened medially in lateral view, parameres short (fig. 36); sipho short, feebly curved (fig. 37).

Type-material.—Holotype, intercepted Brownsville, Texas, ex. Mexico, 4-IX-1946, with orchid plant (USNM 73761).

Remarks.—Male genitalia should be examined to accurately identify this species. Externally it resembles *S. pygmaeus* and *S. apterus* and is difficult to distinguish from either of those species without either dissection of the genitalia or examination for presence or absence of wings. The specific name is a Latin noun meaning orchid in the diminutive.

Scotoscymnus stephensi Gordon, **new species**

Holotype.—Male, length 1.0 mm., greatest width 0.62 mm. Form oval, somewhat elongate (fig. 5), convex. Color piceous; head and ventral surface dark reddish brown; mouthparts, antennae, and legs light yellowish brown. Head shiny, finely punctured, punctures separated by less than to 4 times a diameter. Pronotum smooth, polished, punctures finer than on head, separated by less than to 4 times a diameter; anterolateral line separated from anterolateral angle by width of basal antennal segment, joining lateral border; lateral border with wide, flat margin as in (fig. 13). Elytron shiny, faintly alutaceous, coarsely punctured, punctures separated by a diameter; pubescence composed of intermixed, erect long hairs and semi-erect short hairs; lateral border thickened, forming a flat, wide ridge with moderately deep groove between ridge and disc of elytron. Functional wing and humeral callus present. Ventral surface smooth, polished, finely punctured, punctures and pubescence becoming dense on last 3 abdominal sterna. Postcoxal line as in fig. 21. Genitalia laterally compressed, sinuate on ventral margin in lateral view (fig. 38); sipho feebly curved (fig. 39).

Allotype.—Female, similar to holotype except for sexual characters. Genitalia with spermathecal capsule composed of a large basal area, a small intermediate area and a median apical area (fig. 27).

Type-material.—Holotype, Panama, Boc. d. Toro, Changuinola, 20-VI-65, C.S.S. Stephens, on banana scale, (USNM 73762). Allotype and 1 paratype, same data as holotype (USNM). One paratype, ex. Costa Rica, 21-VI-1968, on orchids (USNM).

Varaiation.—The specimen from Costa Rica is slightly paler in color than the rest of the series.

Remarks.—The coarse elytral punctation and wide, flat, lateral margin on the pronotum are characteristic of this species. It most nearly resembles *S. facetus,* but *S. facetus* has a narrow pronotal margin and the anterolateral pronotal line is extremely close to the angle. The postcoxal lines of both species are also distinctive (figs. 26, 27). This species is named for the collector of the type series.

Scotoscymnus perpusillus Gordon, **new species**

Holotype.—Male, length 1.0 mm, greatest width 0.63 mm. Form oval, somewhat elongate, convex. Black; pronotum dark reddish piceous, head slightly paler; mouthparts, antennae, and legs brownish yellow; ventral surface dark reddish brown except apical abdominal sterna slightly paler. Head shiny, punctures very fine, barely perceptible. Pronotum shiny, alutaceous, punctures extremely fine, widely separated; anterolateral line separated from anterolateral angle by less than width of basal antennal segment, joining lateral border. Elytron shiny, faintly alutaceous, punctures fine but obvious, separated by 1 to 3 times a diameter; pubescence composed of intermixed long, erect hairs and short, semi-erect hairs; lateral border thickened, forming a flat, wide ridge, no groove present between ridge and disc of elytron. Functional wing and humeral callus present. Ventral surface smooth, polished, with some sparse pubescence becoming dense on last 2 abdominal sterna. Postcoxal line as described for *S. colombianus.* Genitalia similar to those of *S. stephensi* except apex of basal lobe more acute in lateral view (figs.40, 41).

Type-material.—Holotype, intercepted at New York, New York, ex. Colombia, VIII-1-1935, on banana (USNM 73763).

Remarks.—This species most nearly resembles *S. colombianus* except that the lateral elytral ridge in *S. colombianus* is not flat and *S. colombianus* has a distinct, deep groove between the ridge and the disc of the elytron.The male genitalia are very similar to those of *S. stephensi* but the elytral punctures of *S. stephensi* are at least twice the size of those possessed by *S. perpusillus* and are separated by a diameter. The specific name is a Latin adjective meaning very small.

Scotoscymnus colombianus Gordon, **new species**

Holotype.—Male, length 1.0 mm., greatest width 0.62 mm. Form oval, somewhat elongate (fig. 6), convex. Dark reddish piceous; head and pronotum a clear reddish brown; mouthparts, antennae, and legs yellowish brown; ventral surface dark reddish brown except apical abdominal sterna slightly paler. Head feebly shiny, surface alutaceous, punctures fine, sparse. Pronotum shiny, smooth, punctures coarser than on head, separated by less than to 3 times a diameter; anterolateral line separated from anterolateral angle by width of basal antennal segment, joining lateral border. Elytron shiny, faintly alutaceous, punctures coarser than on pronotum, separated by less than to twice a diameter; lateral border thickened, not flat, an obliquely angled ridge with deep groove between ridge and disc of elytron present. Functional wing and humeral callus present. Ventral surface smooth, polished, finely punctured, punctures and pubescence becoming dense on last 3 abdominal sterna. Postcoxal line as in fig. 22. Genitalia with basal lobe curved in ventral view, laterally flattened, broad in lateral view (fig. 42); sipho feebly curved near base, apical 3/4 nearly straight (fig. 43).

Type-material.—Holotype, intercepted at Miami, Florida, ex. Colombia, 1963, on orchids (USNM 73764).

Other material.—1 specimen, Colombia, Palmira, Valle del Cauca, 18-V-1939, 1085 m., Murillo (USNM).

Remarks.—See remarks under *S. perpusillus.* The male genitalia of *colombianus* are not closely similar to any species of *Scotoscymnus* described herein. The single female specimen listed under "other specimen" differs from the holotype in having the head more polished and distinctly punctured, the dorsal color a reddish brown. In other respects, it appears identical to the holotype. The female spermathecae of this specimen is illustrated in fig. 28. The specific name is a Latin adjective referring to the country of origin.

TRIBE MICROWEISINI

Microweisini: Leng 1920:213.—Sasaji 1968:20.

Pharini: Casey 1899:110.—Korschefsky 1931:209.—Pope 1962:267 (in part) (type-genus preoccupied).

Sticholotidinae with dorsal surface usually not pubescent, if so, then hairs of uniform length, size minute. Head capsule with prolonged frons and clypeus emarginate around antennal insertion (fig. 47); eye small, facets ranging from extremely coarse to fine; mandible without apical or basal teeth; apical segment of maxillary palpus slender, tapered at apex (fig. 59); antenna 7 to 10-segmented. Pronotum with oblique anterolateral line inside anterolateral angle (except *Gnathoweisea schwarzi*). Intercoxal process of prosternum broad, T-shaped (fig. 62). Leg simple, tibia unmodified; tarsus cryptotetramerous or trimerous. Functional wing present (except *Microcapillata*). Abdomen with 6 visible sterna; basal sternum with divided postcoxal lines (figs. 67, 68). Male genitalia asymmetrical, phallobase with unpaired, basal apodeme (fig. 72). Female spermathecal capsule bulbous (fig. 69).

This tribe is represented in the New World by 8 genera that occur from southern Canada to Chile and Argentina. Members of these genera are apparently all scale feeders, but specific host data are lacking for all genera except *Microweisea* and *Coccidophilus* as listed below. Host data seen for members of *Microweisea* include *Melanaspis obscura* (Comstock) (obscure scale); *Pseudaonidia duplex* (Cockerell) (camphor scale); *Quadraspidiotus perniciosus* (Cockerell) (San Jose scale); *Lepidosaphes beckii* (Newman) (purple scale); *Lepidosaphes* sp. Host data for *Coccidophilus* includes *Chionaspis pinifoliae* (Fitch) (pine needle scale); *Lepidosaphes beckii* (Newman) (purple scale); *Aspidiotus* sp.; *Aonidiella aurantii* (Maskell) (California red scale); *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (white peach scale); *Chrysomphalus aonidium* (L.) (Florida red scale).

Microweisini is a closely knit group of genera agreeing quite well in all essential characteristics. The small size, characteristic habitus, the almost universal presence of an anterolateral line on the pronotum, divided postcoxal line, and broad, T-shaped intercoxal process of the prosternum serve to diagnose this tribe. All New World genera except *Microcapillata* and *Sarapidus* possess trimerous tarsi.

The tribal name Microweisini first appeared in the Leng checklist (1920, p. 213) but has not been used by subsequent authors. Prior to the preparation of this paper, I previously considered the New World genera such as *Microweisea* to belong in the Sticholotidini but here recognize Microweisini and Sticholotidini as discrete entities.

In addition to the New World genera discussed here, I have examined specimens of *Diloponis* Pope (South Africa) and cannot exclude it from Microweisini. The genus *Dichaina* Weise (Australia) also seems to belong in this tribe. I have not seen an example of *Dichaina* but the description places it here. Pope (1962) could not locate types or other specimens but thought that *Dichaina* must be allied to *Coccidophilus* and *Microweisea*, an opinion with which I concur.

KEY TO THE NEW WORLD GENERA OF MICROWEISINI

1. Head entirely concealed beneath pronotum (fig. 46) ...... *Nipus* Casey
1′. Head partially or not at all concealed 2

2(1′). Head partially concealed beneath pronotum, extremely elongate, slender (fig. 49) .... *Gnathoweisea* Gordon
2′. Head not concealed beneath pronotum, usually short, if elongate then elytra pubescent 3

3(2′). Apical segment of maxillary palpus short, broad, obliquely truncate at apex (fig. 57); tarsus cryptotetramerous (fig. 65) .... *Sarapidus*, n. gen.
3′. Apical segment of maxillary palpus not as described above; tarsus trimerous 4

4(3′). Elytron pubescent 5
4′. Elytron glabrous 6

5(4). Pubescence long, erect, sparse (fig. 45); Chile .... *Stictospilus* Brèthes
5′. Pubescence short, erect, dense (fig. 44); Mexico .... *Microcapillata*, n. gen.

6(4′). Antenna with 3-segmented club (fig. 52) .... *Microweisea* Cockerell
6′. Antenna with 2-segmented club (fig. 53) 7

7(6′). Pronotum with longitudinal black mark .... *Pseudosmilia* Brèthes
7′. Pronotum unicolorous .... *Coccidophilus* Brèthes

Microcapillata Gordon, **new genus**

Microweisini with form elongate, oval; dorsum with short, dense pubescence. Head extremely prolonged anterior to antennal insertions (fig. 47); eye small, widely separated, very coarsely faceted; antenna with 7-segmented scape, 3-segmented club; apical segment of maxillary palpus slender, strongly narrowed apically. Prosternum with anterior lobe. Tarsus cryptotetramerous. Type-species: *Microcapillata clypealis*, new species.

The eyes in members of this tribe are often coarsely faceted, but those of *Microcapillata* are extremely so. The short, dense, dorsal pubescence is also unique as other hirsute genera such as *Stictospilus* and *Sarapidus* either have long hairs or, if short, then extremely sparse. The generic name is a combination of Latin terms meaning small and pubescent, and the gender is feminine.

Microcapillata clypealis Gordon, **new species**

Holotype.—Male, length 1.16 mm, greatest width 0.84 mm. Color mostly yellowish brown, elytron darker reddish brown. Dorsal surface completely pubescent, pubescence short, uniform individual hairs shorter than scutellum. Head dull, strongly alutaceous, finely punctured, punctures separated by 1 to 3 times their diameter. Pronotum dull, strongly alutaceous, finely punctured, punctures nearly invisible, separated by 1 to 3 times a diameter; anterolateral line widely separated from anterolateral angle, joining inner margin of wide lateral border. Elytron shiny, densely, finely punctured, punctures separated by a diameter or less. Functional wing lacking. Ventral surface smooth, polished, sparse pubescence present on abdominal sterna. Genitalia with phallobase short, broad; basal lobe bent to the left in ventral view (fig. 70); sipho as in fig. 71.

Type-material.—Holotype, interception, ex. Mexico, San Luis Potosi, Dec. '55, Watt, on orchids (USNM 73766).

Remarks.—The type was intercepted at the United States border and was found on orchids as were many of the specimens of *Scotoscymnus.* See remarks concerning this under the generic discussion of that genus. The specific name is a Latin adjective referring to the clypeus, gender is feminine.

Sarapidus Gordon, **new genus**

Microweisini with form elongate, oval; dorsum mostly glabrous except elytron with sparse, short, semi-erect hairs. Head slightly prolonged anterior to antennal insertion; eye separated by 5 times the width of an eye; apical segment of maxillary palpus short, broad, apex oblique (fig. 57); antenna with 7-segmented scape, 3-segmented club (fig. 50). Prosternum with small anterior lobe. Tarsus cryptotetramerous (fig. 65). First abdominal sternum with postcoxal lines nearly joined (fig. 67). Male genitalia with basal capsule and basal lobe asymmetrical, parameres symmetrical (fig. 72). Type-species: *Sarapidus australis*, new species.

The form of the apical maxillary segment and antennal club are unique within the Microweisini. In addition, the character of cryptotetramerous tarsi is shared only with *Microcapillata.* No biological information is available. The generic name is an anagram, and the gender is masculine.

Sarapidus australis Gordon, **new species**

Holotype.—Male, length 1.40 mm, greatest width 0.90 mm. Color piceous; elytron yellowish red with basal fourth and apical piceous. Dorsal surface sparsely pubescent, hairs as long as scutellum. Head shiny, faintly alutaceous, finely punctured, punctures separated by 3 to 6 times a diameter. Pronotum smooth, shiny, finely punctured, punctures separated by 2 to 4 times a diameter; anterolateral line widely separated from anterolateral angle, joining inner margin of narrow lateral border. Elytron shiny, faintly alutaceous, coarsely punctured, punctures separated by a diameter or slightly more. Functional wing present. Ventral surface smooth, polished, sparse pubescence present on abdominal sterna. Genitalia with basal lobe slightly asymmetrical; parameres symmetrical (fig. 72); sipho extremely long (fig. 73).

Type-material.—Holotype, Chile, Coll. Oyarzun (USNM 73825). Paratypes, 3, 2 with same data as holotype. One paratype, Chile, Magellanes, Punta Arenas, Dec. 4, 1954, T. Cekalovic (USNM).

Remarks.—This species occurs farther south (Punta Arenas) than any other coccinellid I have seen, and this may account for the lack of specimens present in collections. Both the habitus and male genitalia are distinctive, as are the maxillary palpi and tarsi. The specific name is a Latin adjective referring to the extreme southern distribution of this species.

Stictospilus Brèthes

Stictospilus Brèthes 1924:154.—Pope 1962:638. Type-species: *Stictospilus darwini* Brèthes, by monotypy.

Microweisini with form elongate, oval; dorsum with long, sparse, mostly erect hairs (fig. 45). Head slightly prolonged anterior to antennal insertion; eyes separated by less than 4 times the width of an eye; apical segment of maxillary palpus short, barrel-shaped (fig. 58); antenna with 7-segmented scape, 2-segmented club (fig. 51). Prosternum with extremely expanded anterior lobe (fig. 63). Tarsus trimerous.

Stictospilus is represented by an uncommonly collected species, *S. darwini* Brèthes. Nothing is known of the biology or preferred hosts. The presence of long, erect hairs on the dorsum is unique in this tribe and the strongly expanded prosternal lobe is similar only to that possessed by members of *Nipus*.

Because I have seen the type-series of *S. darwini* in the British Museum, I here take the opportunity to designate a lectotype and 2 paralectotypes. The lectotype is labeled "Syntype/Chiloe/Chiloe I. Chile C. Darwin/ Darwin Coll. 1885-119/Stictospilus darwini Brèthes". One paralectotype is labeled "Syntype/Paratype/Chili/Stictospilus darwini Brèthes". One paralectotype is labeled "Syntype/Valle del Lago Blanca. Patagonia 1903, 319/Stictospilus darwini Brèthes".

Microweisea Cockerell

Microweisea Cockerell 1903:38 (new name for *Epismilia* Cockerell 1900). Pope 1962:637.—Gordon 1970c:207. Type-species: *Smilia felschei* Weise, by monotypy.

Smilia Weise 1891:288 (not Germar 1833).

Epismilia Cockerell 1900:606 (not Fromental 1861) (new name for *Smilia* Weise).

Pseudoweisea Schwarz 1904:118. Name made available by accident.

Microweisini with form elongate, oval; dorsum glabrous. Head slightly prolonged anterior to antennal insertion (fig. 48); eyes separated by 4 times the width of an eye; apical segment of maxillary palpus elongate, slender, conical; antenna with 7-segmented scape, 3-segmented club (fig. 52). Prosternum with small anterior lobe. Tarsus trimerous (fig. 66). Male genitalia asymmetrical, parameres reduced (fig. 74).

Microweisea was reviewed by Gordon (1970c) and contained 5 species from America north of Mexico. I have since seen several undescribed species from Mexico and South America. This genus is very close to *Coccidophilus,* but at present the differences between them seem sufficient to warrant their continued separation.

Coccidophilus Brèthes

Coccidophilus Brèthes 1905:1.—Costa Lima 1941:409.—Pope 1962:638.—Gordon 1970c:213. Type-species: *Coccidophilus citricola* Brèthes, by monotypy and original designation.

Cryptoweisea Gordon 1970c:213. Type-species: *Pentilia marginata* Le Conte. **New synonymy.**

Microweisini with form elongate, oval; dorsum apparently glabrous. Head slightly prolonged anterior to antennal insertion; eyes separated by 4 times the width of an eye; apical segment of maxillary palpus usually short, barrel shaped (fig. 58), but often elongate, conical; antenna with 7-segmented scape and 2-segmented club (fig. 53). Prosternum with small anterior lobe (fig. 62). Tarsus trimerous. Male genitalia asymmetrical, parameres reduced (figs. 75, 76).

Coccidophilus has not been reviewed since 1941 when Costa Lima discussed both *Coccidophilus* and *Pseudosmilia*. There are several undescribed species present in South America. I here add the 3 species previously placed in *Cryptoweisea* Gordon. The differences between *Coccidophilus* and *Cryptoweisea* cited by Gordon (1970c) are not constant when South American species are examined, and I here place *Cryptoweisea* as a junior synonym of *Coccidophilus*. I have not seen any examples of this genus from Central America, and there seems to be a gap in distribution between the United States and South America except for a single species occuring in Baja California.

Pseudosmilia Brèthes

Pseudosmilia Brèthes 1924:157.—Costa Lima 1941:409.—Pope 1962:638. Type-species: *Pseudosmilia arrowi* Brèthes, by monotypy.

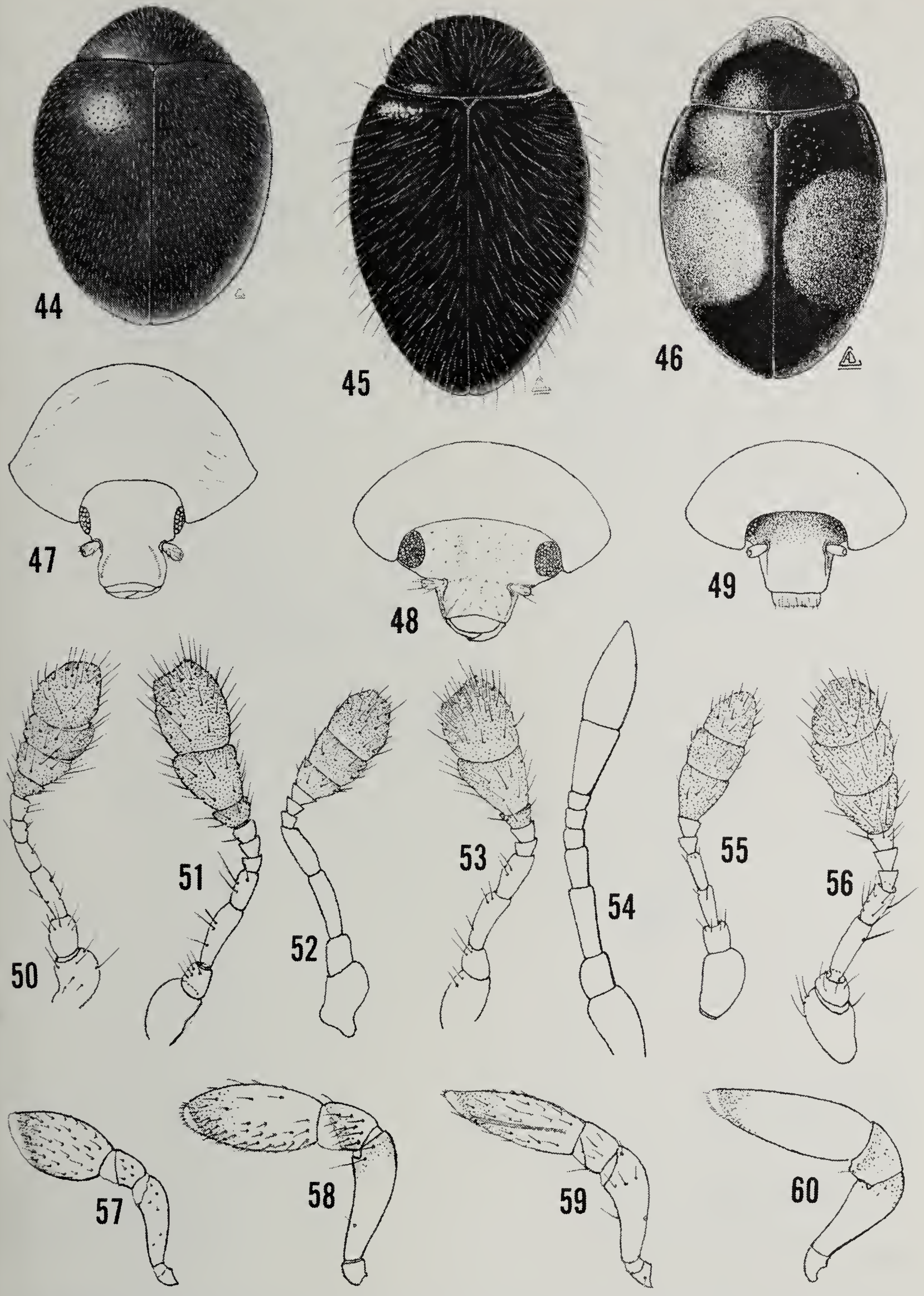
There is little doubt that this monotypic genus is close to *Coccidophilus,* and the 2 may be congeneric. The type of *Pseudosmilia arrowi* is supposed to be in the British Museum, but all that remains there is a pin with the specimen missing labeled "Type". I have not seen specimens from Chile (the type-locality) or elsewhere that match the original description, and in the absence of such specimens I maintain *Pseudosmilia* as a valid genus. Brèthes described *P. arrowi* as being somewhat pubescent and darkly ferruginous with a longitudinal black mark on the pronotum and a black patch around the scutellum. He also illustrated the antenna (fig. 54) which appears quite different from that of *Coccidophilus* (fig. 53), but if the antennae of *Coccidophilus* are viewed from the side rather than dorsally or ventrally, then they somewhat resemble Brèthes illustration.

Gnathoweisea Gordon

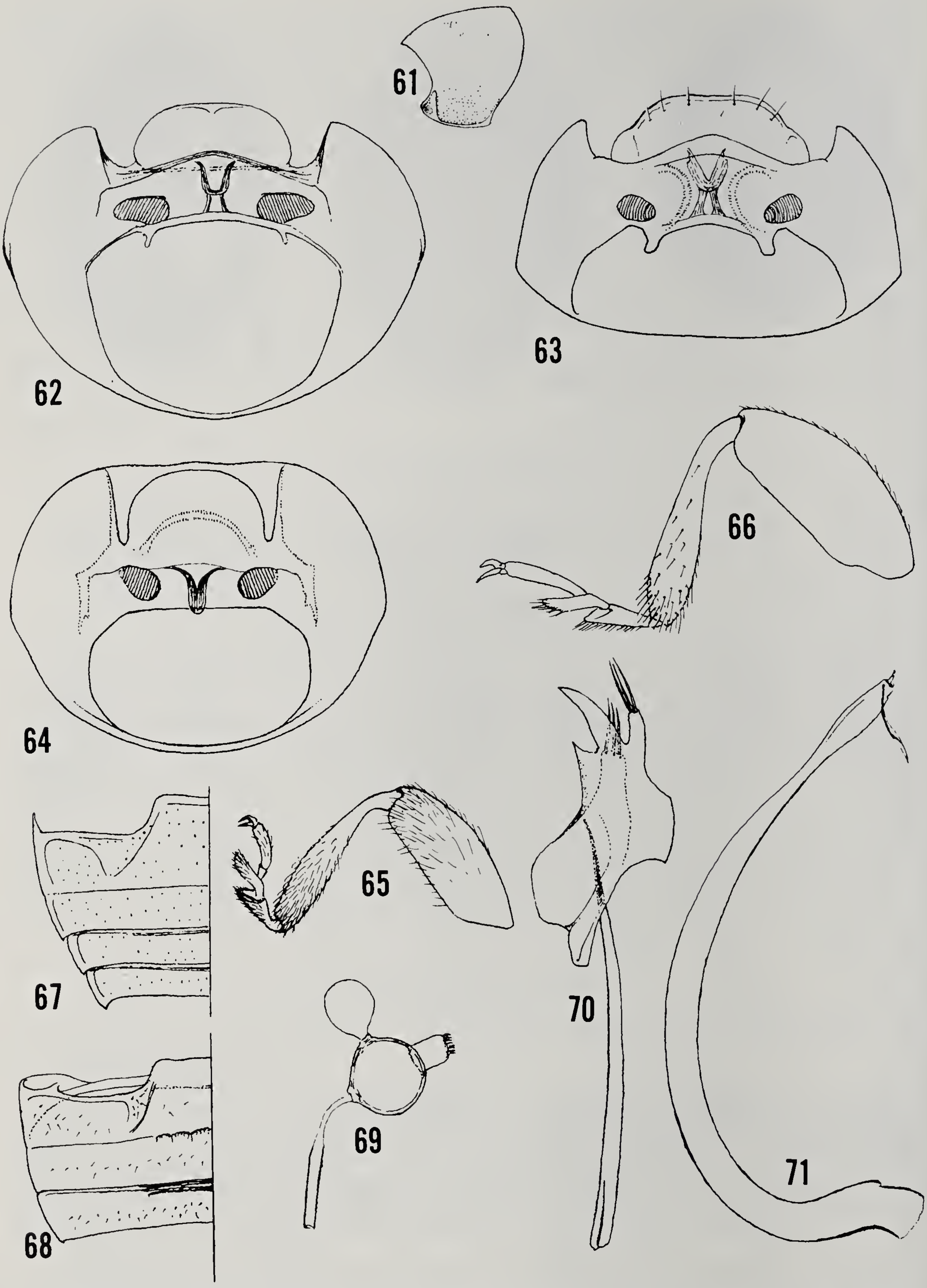
Gnathoweisea Gordon 1970:47. Type-species: *Smilia planiceps* Casey, by original designation.

Microweisini with form elongate, oval, pronotum partially covering head; dorsum glabrous. Head extremely elongate anterior to antennal insertion, lateral border margined (fig. 49); eyes separated by 6 times the width of an eye, very coarsely faceted; apical segment of maxillary palpus elongate, slender, conical; antenna with 6-segmented scape, 3-segmented club (fig. 55). Prosternum with or without anterior lobe. Tarsus trimerous. Male genitalia asymmetrical, parameres somewhat reduced.

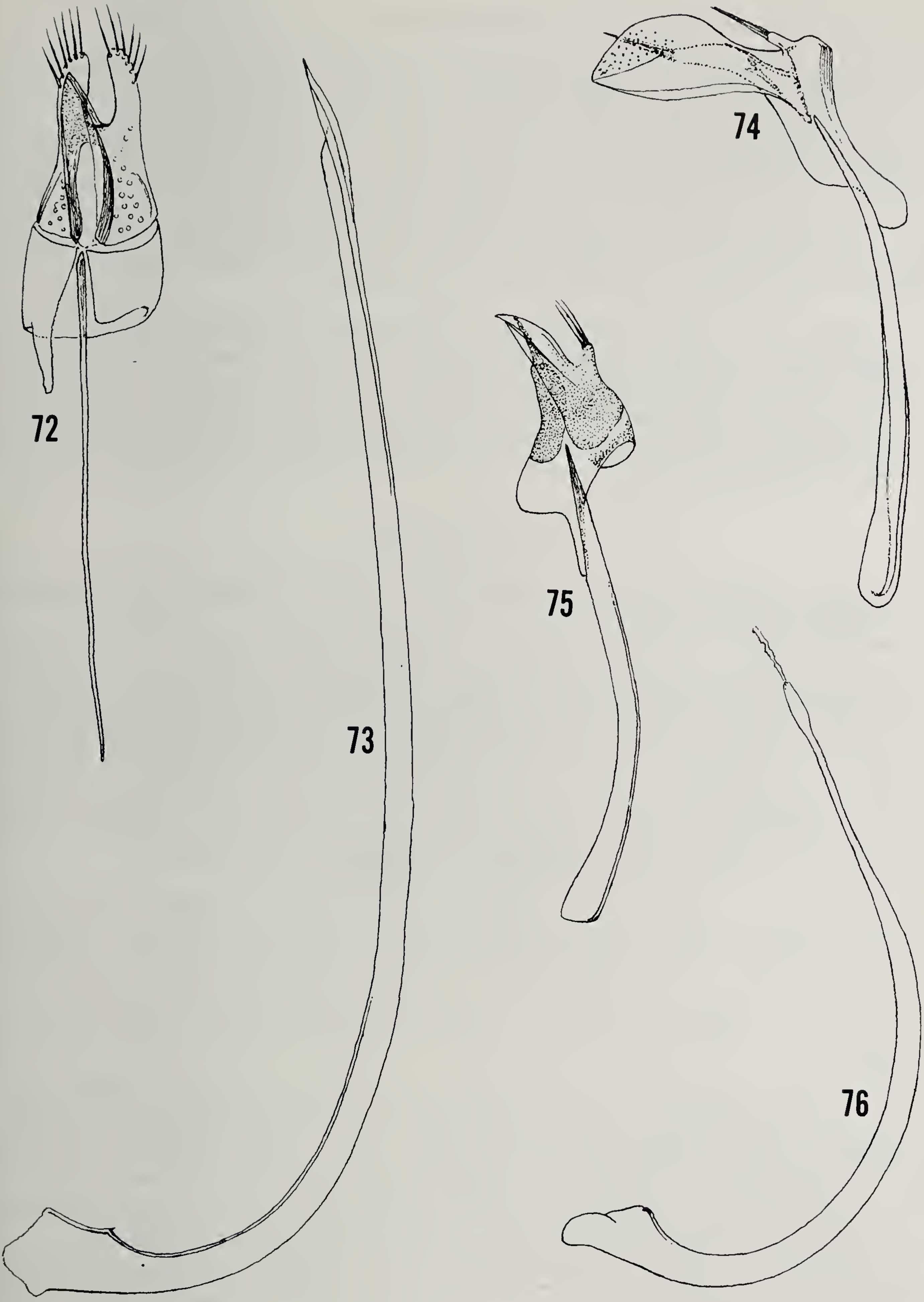
This genus was treated by Gordon (1970b) and contains 2 described species from Arizona and California. The preferred hosts are unknown, but *G. planiceps* has been taken from *Pinus monophylla* and evidently must feed on a scale infesting that tree. The partially covered head is a condition intermediate between those of *Microweisea* and *Nipus.* The presence of lobed and unlobed prosterna within the same genus of Microweisini seems incongruous, but I can find no other substantive supporting differences and prefer to consider the 2 species as congeneric.



Figs. 44-60. Figs. 44-46, habitus views: 44, *Microcapillata clypealis*; 45, *Stictospilus darwini*; 46, *Nipus occiduus*. Figs. 47-49, heads: 47, *Microcapillata clypealis*; 48, *Microweisea misella*; 49, *Gnathoweisea planiceps*. Figs. 50-56, antennae: 50, *Sarapidus* sp.; 51, *Stictospilus darwini*; 52, *Microweisea misella*; 53, *Coccidophilus* sp.; 54, *Pseudosmilia arrowi*; 55, *Gnathoweisea planiceps*; 56, *Nipus occiduus*. Figs. 57-60, apical segment of maxillary palpi: 57, *Sarapidus australis*; 58, *Stictospilus darwini*; 59, *Microweisea misella*; 60, *Coccidophilus* sp.



Figs. 61-71. Fig. 61, lateral view of pronotum, *Microweisea misella*. Figs. 62-64, prosterna: 62, *Coccidophilus* sp.; 63, *Stictospilus darwini*; 64, *Nipus biplagiatus*. Figs. 65-71: 65, leg. *Sarapidus australis*; 66, leg, *Microweisea misella*; 67, abdomen, *Sarapidus australis*; 68, abdomen, *Microweisea misella*; 69; spermatheca, *Microweisea misella*; 70, 71, male genitalia, *Microcapillata clypealis*.



Figs. 72-76, male genitalia: 72, 73, *Sarapidus australis*; 74, *Microweisea misella*; 75, 76, *Coccidophilus* sp.

Nipus Casey

Nipus Casey 1899:132.—Gordon 1970a:71. Type-species: *Nipus biplagiatus* Casey, by subsequent designation of Korschefsky 1931.

Microweisini with form oval; dorsum glabrous or partially pubescent; pronotum completely concealing head (fig. 46). Head strongly elongate anterior to antennal insertion (not as elongate as in *Gnathoweisea*); eyes separated by 3 times the width of an eye; apical segment of maxillary palpus elongate, somewhat conical; antenna with 7-segmented scape, 3-segmented club (fig. 56). Prosternum with anterior lobe pronounced, semicircular, nearly concealing mouthparts ventrally (fig. 64). Tarsus trimerous. Male genitalia asymmetrical, parameres reduced.

Nipus was reviewed by Gordon (1970a) and contains 4 species from Arizona and California. No information is available concerning the preferred hosts. This genus is readily distinguished from other genera of Microweisini because the head is completely concealed beneath the pronotum. The partially concealed head found in *Gnathoweisea* is the only remotely similar condition known.

Tribe Serangiini

Serangiini: Blackwelder 1945:450.—Pope 1962:627.—Sasaji 1967:2—Sasaji 1968:20.—Gordon 1970d:356.

Sticholotidinae with form compact; dorsally pubescent or not. Head slightly prolonged anterior to antennal insertion, emarginate around insertion; eye coarsely faceted (fig. 77); apical segment of maxillary palpus either elongate, conical, or short, barrel shaped; antenna 8 or 9-segmented, club composed of a single segment (figs. 78, 79). Prosternum strongly lobed anteriorly, concealing mouthparts (fig. 77), notched on each side for reception of antenna. Epipleuron with fovea for reception of leg. Leg received in deep cavity on ventral surface; at least front femur broad, flat, concealing tibia when leg retracted; at least front tibia angulate externally; tarsus cryptotetramerous or trimerous. Abdomen with 5 visible sterna; postcoxal line on first sternum complete. Male genitalia asymmetrical, parameres reduced.

This tribe is represented in the New World by the native genus *Delphastus* and an introduced genus and species, *Catana clauseni* Chapin. *Catana clauseni* occurs only in Cuba where it was intentionally introduced for control of the citrus blackfly (*Aleurocanthus woglumi* Ashby). The area of origin was Indonesia, and the introduction was made in 1930 (Chapin, 1940).

Delphastus was reviewed by Gordon (1970d) and contains 12 species distributed from southern Canada to Argentina. Available host records for *Delphastus* are: *Aleurocanthus woglumi* Ashby (citrus blackfly); *Pelius kelloggi* (Bemis); *Trialeurodes floridensis* (Quaintance). These hosts are all whiteflies (Aleyrodidae), and available evidence on host selection in the Serangiini indicates that they are mostly restricted to whiteflies.

A series of a species of *Delphastus* in the USNM collection bears the host data "on *Asterolecanium miliaris* (Boisduval)" (a scale insect). Kamiya (1966) records *Serangium japonicum japonicum* Chapin as feeding on the scales *Ceroplastes rubens* Maskell and *Ceroplastes japonicus* Green in Japan.

There are currently 6 genera placed in this tribe, all of Oriental origin except *Delphastus*. Miyatake (1961) provided a key to the 5 Oriental genera. Chapin (1940) and Miyatake (1961) have provided excellent illustrations of the pertinent morphological details of members of this tribe, and I have not repeated them here.

KEY TO GENERA OF WESTERN HEMISPHERE SERANGIINI

1. Antenna 8-segmented (fig. 79); middle and hind tibiae not angulate externally .... *Catana* Chapin
1′. Antenna 9-segmented (fig. 78); middle and hind tibiae angulate externally .... *Delphastus* Casey

Catana Chapin

Catana Chapin 1940:266. Type-species: *Catana clauseni* Chapin, by original designation.

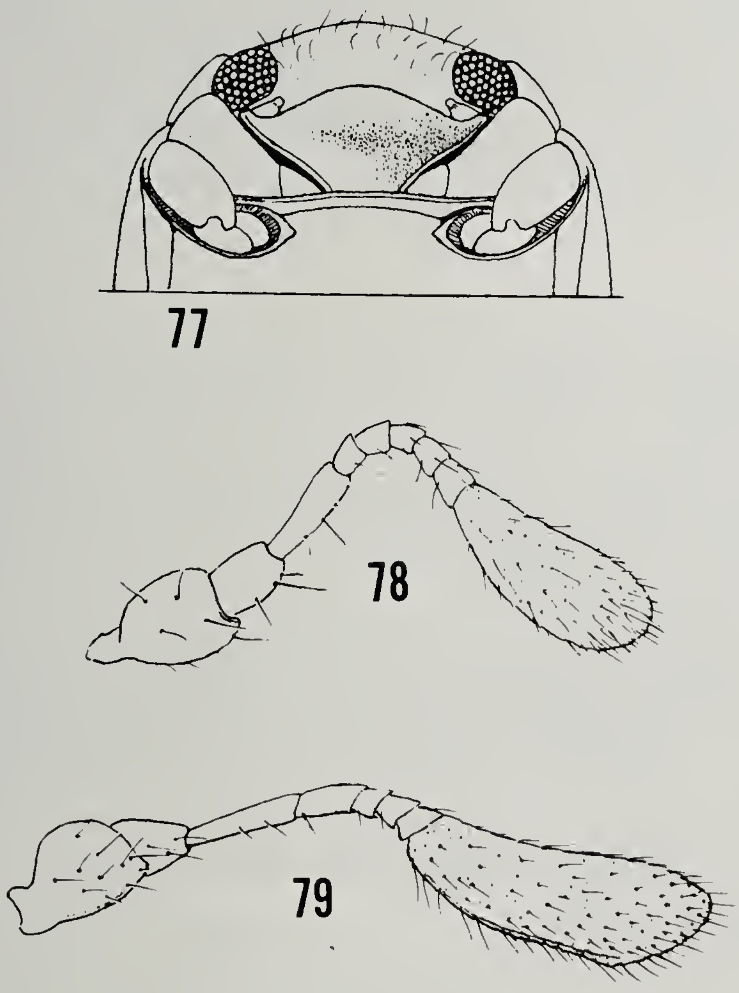
Serangiini with nearly hemispherical form. Head with apical segment of maxillary palpus barrel-shaped; antenna 8-segmented (fig. 79). Elytron without sutural line. Epipleuron slightly descending externally. Leg with femur broad; tibia slender, middle and hind tibiae not angulate externally; tarsus cryptotetramerous.

There are approximately 5 described species in this genus, all oriental, with one species introduced into Cuba as indicated in the tribal discussion.

Delphastus Casey

Delphastus Casey 1899:111.—Korschefsky 1931:220.—Chapin 1940:264.—Gordon 1970d:357. Type-species: *Oeneis pusillus* LeConte, by subsequent designation of Korschefsky 1931.

Serangiini with form hemispherical, slightly elongate. Head with apical segment of maxillary palpus slender, somewhat conical; antenna 9-segmented (fig. 78). Elytron without sutural line. Epipleuron not descending externally. Leg with femur broad; tibia angulate externally; tarsus trimerous.



Figs. 77-79. Fig. 77, ventral surface of prosternum, *Delphastus pusillus*; 78, antenna, *Delphastus pusillus*; 79, antenna, *Catana clauseni*.

Delphastus is very similar to *Catana* in appearance but the key characters as well as the difference in tarsal segments will readily separate them. Members of *Delphastus* occur only in the New World and the 12 described species occur mostly from Mexico and the West Indies southward. One species, *Delphastus pusillus* (LeConte), is widespread in the United States and occurs as far north as Michigan.

TRIBE STICHOLOTIDINI, **emendation**

Sticholotini: Weise 1901:430.—Sasaji 1967:11.—Sasaji 1968:19.
Pharini: Casey 1899:110.—Korschefsky 1931:209.—Pope 1962:627 (in part) (type genus preoccupied).
Pseudococcinellidae: Weise 1887:185.—Weise 1893:105.—Weise 1899:372.—Sicard 1907:426.—Sicard 1909:150 (not available, no type-genus).
Coelopterini: Della Beffa 1912:171.—Korschefsky 1931:209.
Coelopterina: Jacobson 1904-1916 (1916):969.—Korschefsky 1931:209.

Sticholotidinae, form subhemispherical; dorsally pubescent or glabrous. Head with anterior clypeal margin usually more or less truncate, gena rarely extending onto eye above antennal insertion (*Lotis, Glomerella*). Antenna inserted under clypeus anterior to eye or insertion exposed. Pronotum without line or ridge separating anterolateral angle from disc. Scutellum visible but reduced in *Glomerella*. Elytron confusedly punctured with surface usually polished, shiny. Functional wing usually present. Prosternum usually with longitudinal ridges on process between front coxae, anterior margin of prosternum often produced downward or slightly projecting. Epipleuron flat or descending externally, foveate or not for reception of femur. Abdomen with 5 visible sterna. Leg with tarsal claw simple or nearly so. Male genitalia usually symmetrical.

With the recognition of the tribes Sukunahikonini and Microweisini, the Sticholotidini become a slightly more compact entity, with somewhat definable characteristics. I have not studied the Old World genera in detail, but it is apparent from a cursory examination that this tribe is composed of a heterogenous assemblage of genera. When a thorough study is undertaken, new tribes will certainly have to be formed to include genera now in the Sticholotidini.

I recognize 4 genera of new world Sticholotidini, 3 of which are described here for the first time. None are comprised of more than 3 species, and the species are usually represented by severely limited type material. This suggests that there still remain other undescribed genera and species in the Neotropical Region. The known genera form a diverse assemblage, but I suspect that genera as yet unrecorded will at least partially close existing gaps in the scheme.

I previously (1970e) assigned the genus *Microscymnus* to the Sticholotidini, but, after reassessment of the characteristics of that genus, I now exclude it. The affinities of *Mycroscymnus* are not readily apparent but are most likely with *Pentilia* and *Crytognatha* in the Cryptognathini.

KEY TO GENERA OF NEW WORLD STICHOLOTIDINI

1. Form extremely convex (fig. 84); epipleuron foveate for reception of femur .... *Glomerella*, n. gen.
1′. Form normally convex; epipleuron not foveate for reception of femur 2
2(1′). Apical segment of maxillary palpus long, slender, strongly narrowed apically (fig. 85) .... *Nexophallus* Gordon
2′. Apical segment of maxillary palpus wide, not strongly narrowed apically 3
3(2′). Prosternum with intercoxal process somewhat triangular, strongly raised (fig. 98) .... *Neotina*, n. gen.
3′. Prosternum with intercoxal process rectangular, slightly raised (fig. 92) .... *Nesina*, n. gen.

Nexophallus Gordon

Nexophallus Gordon 1969:93. Type-species: *Nexophallus semiglobus* Gordon, by original designation.

Sticholotidini with form round, strongly convex (fig. 80); dorsum faintly pubescent. Head broad (fig. 89); clypeus short, truncate anteriorly; eyes small, widely separated; antenna inserted under anterior angle of clypeus anterior to eye; antenna with scape 7-segmented, club 3-segmented; mandible with 2 teeth; apical segment of maxillary palpus long, slender, narrowed apically (fig. 85). Epipleuron broad basally, slightly descending externally, not foveate for reception of femur. Prosternum with small anterior projection, posterior projection rectangular, widely separating middle coxae. Legs with all femora swollen and grooved for reception of tibiae; all tibiae thickened medially; tarsus cryptotetramerous. Abdomen with 5 visible sterna, first sternum with complete postcoxal lines. Functional wing present. Male genitalia symmetrical or asymmetrical.

With the new species described herein there are 3 species in *Nexophallus*. All are from South America (Bolivia, Ecuador and Brazil) and form a compact genus based on external characters. The male genitalia are extremely different in each species, showing no apparent relationship with one another. See Gordon (1969) for a discussion of the genus and illustrations of morphological characters. *Nexophallus* is the only new world genus of Sticholotidini thus far described possessing the strongly narrowed apical segment of the maxillary palpus, somewhat resembling the genera of Microweisini in this respect. *Nexophallus* most nearly resembles the Old World genus *Sticholotis* as discussed by Gordon (1969).

KEY TO SPECIES OF *Nexophallus*

1. Head and pronotum rufous .... *N. rufoglobus* Gordon
1′. Head and pronotum black 2
2(1′). Elytral punctures fine, nearly invisible .... *N. semiglobus* Gordon
2′. Elytral punctures coarse, separated by a diameter or less .... *N. lindemanni*, n. sp.

Nexophallus lindemanni Gordon, **new species**

Holotype.—Female, length 2.10 mm, greatest width 1.75 mm. Form convex, round (fig. 82). Color rufopiceous; head, pronotum, and legs black; mouthparts and antennae brownish yellow. Head shiny, faintly alutaceous, densely punctured, punctures separated by a diameter or less. Pronotum shiny, faintly alutaceous, punctures equal in size to those on head, separated by 1 to 2 times a diameter. Elytron smooth, polished, densely punctured, punctures slightly coarser than on pronotum, separated by a diameter or less. Prosternum with intercoxal process rough, deeply punctured. Mesosternum with intercoxal area strongly margined anteriorly, deeply punctured. Metasternum with coarse punctures scattered throughout, surface alutaceous. First abdominal sternum with postcoxal line complete, extending slightly more than half the distance to hind margin. Genitalia with spermathecal capsule bent at right angle, sperm duct extremely long, tangled (fig. 88).

Allotype.—Male, similar to holotype in all respects except sexual characters. Genitalia with phallobase slender, symmetrical, parameres half as long as basal lobe; trabes longer than phallobase (fig. 86); sipho with extremely long, coiled apical portion (fig. 87).

Type-material.—Holotype, Brazil, Amazonas, Serra Neblina, N. Rio Cauaburi, 125 mm, 2-IV-1964, C. Lindemann (ZSBS). Allotype and 1 paratype, same data as holotype (USNM) (ZSBS).

Remarks.—The key characters are sufficient to separate the 3 described species in this genus, but in addition, the male genitalia are also extremely different in all 3. The extremely elongate, threadlike, apical portion of the sipho of *N. lindemanni* is very unusual, and the female sperm duct is a correspondingly long, slender structure. This species is named for the collector of the type series.

Nesina Gordon, **new genus**

Sticholotidini with form nearly round, convex, head and pronotum very sparsely pubescent (fig. 81). Head broad, clypeus short, truncate apically; eye large, finely faceted, inner half divided by lateral extension of clypeus, separated by twice the width of an eye (fig. 90); antenna inserted under anterior angle of clypeus anterior to eye; mandible with 2 teeth; apical segment of maxillary palpus short, broad, narrowed toward apex (fig. 91). Elytral epipleuron broad, slightly descending externally, not foveate for reception of femur. Prosternum short, not lobed anteriorly, coxae widely separated (fig. 92). Legs with all femora swollen and grooved for reception of tibiae; tarsus cryptotetramerous. Abdomen with 5 visible sterna, first sternum with complete postcoxal line. Functional wing present. Male genitalia symmetrical. Type-species: *Nesina amazonia*, new species.

The shape of the apical segment of the maxillary palpus is quite different from that found in other new world genera of Sticholotidini, but similar to some old world genera such as *Lotis*. The expansion of the clypeus onto the eye is also a character shared by *Lotis* and *Habrolotis*. The affinities of *Nesina* seem to be with *Lotis* and related genera, most of which possess strongly descending elytral epipleura. *Nesina* has the epipleura slightly descending and lacks the associated foveae for reception of the legs. If *Nesina* and this group of old world genera share a common ancestry, then the split in lineage is an ancient one.

The generic name is an arbitrary combination of letters, and the gender feminine.

Nesina amazonia Gordon, **new species**

Holotype.—Female, length 1.30, greatest width 1.05 mm. Form round, slightly elongate, convex (fig. 81). Head and pronotum with sparse, white pubescence. Color black; elytra dark piceous; ventral surface reddish brown. Head feebly shiny, alutaceous, punctures fine, separated by a diameter. Pronotum shiny, faintly alutaceous, punctures coarser than on head, separated by less than a diameter. Elytron smooth, polished, coarsely punctured, punctures separated by a diameter or less; lateral border feebly, narrowly margined, a row of short, sparse setae present inside margin. Meso- and metasternum coarsely, densely punctured, surface shiny. Abdomen with postcoxal line complete, extending nearly to apex of first sternum (fig. 93). Spermathecal capsule lost.

Allotype.—Male, similar to holotype except for sexual characters. Genitalia with phallobase short, basal lobe slender, straight, longer than paramere (fig. 94); sipho short, robust (fig. 95).

Type-material.—Holotype, Brazil, Amazonas, Serra Neblina, N. Rio Cauaburi, 7700 m, 9-II-1964, C. Lindemann (SZBS). Allotype, Brasilien, Amazonas, Vaupés, Rió Negro 18, 3-II-1964, Chr. Lindemann (USNM).

Remarks.—The type specimens are in poor condition apparently because some deterioration of the intersegmental membranes has taken place prior to mounting. Most of the legs and all antennae are missing.

The specific name is a Latin adjective referring the locality of origin.

Neotina Gordon, **new genus**

Sticholotidini, with form rounded, convex (fig. 82), without pubescence except on lateral margin of elytron. Head broad; clypeus short, nearly truncate apically, anterolateral angles rounded; eye not extremely coarsely faceted, small, separated by 5 times the width of an eye (fig. 96); antenna inserted under anterior angle of clypeus anterior to eye, scape 7-segmented, club 3-segmented (fig. 97); mandible with 2 teeth; apical segment of maxillary palpus short, broad, apex strongly, obliquely angled to produce acute apex. Epipleuron broad, slightly inclined, not foveate for reception of femora. Prosternum with coxae widely separated by a triangular protuberance, not lobed anteriorly (fig. 98). Legs with all femora swollen and grooved for reception of tibiae; tibiae slender, nearly straight; tarsus cryptotetramerous, robust, with dense hairs on ventral surface. Abdomen with 5 visible sterna, first sternum with incomplete postcoxal line (fig. 99). Functional wing present. Male genitalia symmetrical. Type-species: *Neotina cariba*, new species.

The only specimen of this genus thus far known is a male from Cuba. *Neotina* is the only representative of the Sticholotidini known to occur in the West Indies as the other 3 genera are South American. The smooth, broad head, obliquely slanted apical segment of the maxillary palpus, and prosternum with the median protuberance distinguish *Neotina* from these other genera. The most closely allied Old World genus is *Sticholotis*.

The generic name is an arbitrary combination of letters, and the gender is feminine.

Neotina cariba Gordon, **new species**

Holotype.—Male, length 1.60 mm, greatest width 1.40 mm. Form round, convex (fig. 82). Head piceous with greenish tint; pronotum piceous with purplish tint; elytron reddish orange except humeral callus, lateral margin, and apical third dark with purplish tint; ventral surface piceous except mouthparts, antenna, and tarsi brownish yellow. Head shiny, extremely finely alutaceous, finely punctured, punctures nearly invisible, separated by 2 to 5 times a diameter. Pronotum with surface as on head except punctures coarser, separated by 1 to 2 times a diameter. Elytron smooth, polished, punctation dual, large and fine punctures sparsely intermixed; lateral border flanged, abrupt, with fringe of short, widely spaced hairs. Meso- and metasterna shiny, smooth, finely punctured. Abdomen with incomplete postcoxal lines extending to hind margin of first sternum, then outward parallel to suture (fig. 99). Genitalia with basal lobe slender, slightly longer than paramere; trabes short, stout (fig. 100); sipho strongly curved (fig. 101).

Type-material.—Holotype, Cuba, Baracaoa, 1918, WMMann (USNM 73767).

Remarks.—The specific name is a Neolatin noun indicating the Caribbean origin of this species.

Glomerella Gordon, **new genus**

Sticholotidini with form extremely convex (figs. 83, 84); wingless. Head with eyes small, separated by 3-5 times the width of an eye; clypeus projecting somewhat anteriorly; antenna inserted under lateral margin of clypeus anterior to eye, scape 7-segmented, club 3-segmented (fig. 105); mandible with 3 apical teeth (fig. 106); apical segment of maxillary palpus broad, not narrowed anteriorly, cardo with segmented palp-like appendage (fig. 104). Scutellum reduced. Elytron convex, thickened and extremely hardened, epipleuron broad, descending externally, foveate for reception of femur, right elytron fitted with "tongue" on sutural margin, left elytron with groove for reception of tongue; sparsely pubescent. Prosternum lobed anteriorly, coxae widely separated, intercoxal process with 2 median carinae. Meso- and metasterna with depressions for reception of legs. Legs with all femora swollen and grooved for reception of tibiae (figs. 108-110), front tibia grooved and expanded for reception of tarsus; tarsus cryptotetramerous. Abdomen with 5 visible sterna, first sternum with depressions for reception of leg, postcoxal line incomplete (fig. 107). Male genitalia symmetrical. Female genitalia with accessory gland and infundibulum present (fig. 111). Type-species: *Glomerella perconvexa*, new species.

This genus contains the most highly modified species of Coccinellidae known to me. They are completely wingless and have the elytra fitted with a tongue-and-groove locking apparatus. The entire body, including the internal muscle attachments, is hard, rigid and extremely heavily sclerotized. The appendages are retracted into cavities on the ventral surface and the dorsum is smooth, polished and highly convex. These modifications make the specimens difficult for a predator to grasp, hold, or ingest. Very likely the appendages are folded and the beetle drops like a pellet when disturbed.

The affinities of this genus are difficult to determine and do not seem to be with any of the New World genera. The form of the maxillary palpus and the expansion of the clypeus onto the eye are like those of *Lotis* and related genera, but there seem to be no other similarities. The mandibles and structure of the ventral surface resemble those of the South African genus *Pharopsis* Casey, and I consider *Pharopsis* to be the most closely allied of the extant genera. However, the similarities between the 2 genera are too tenuous to be of much significance.

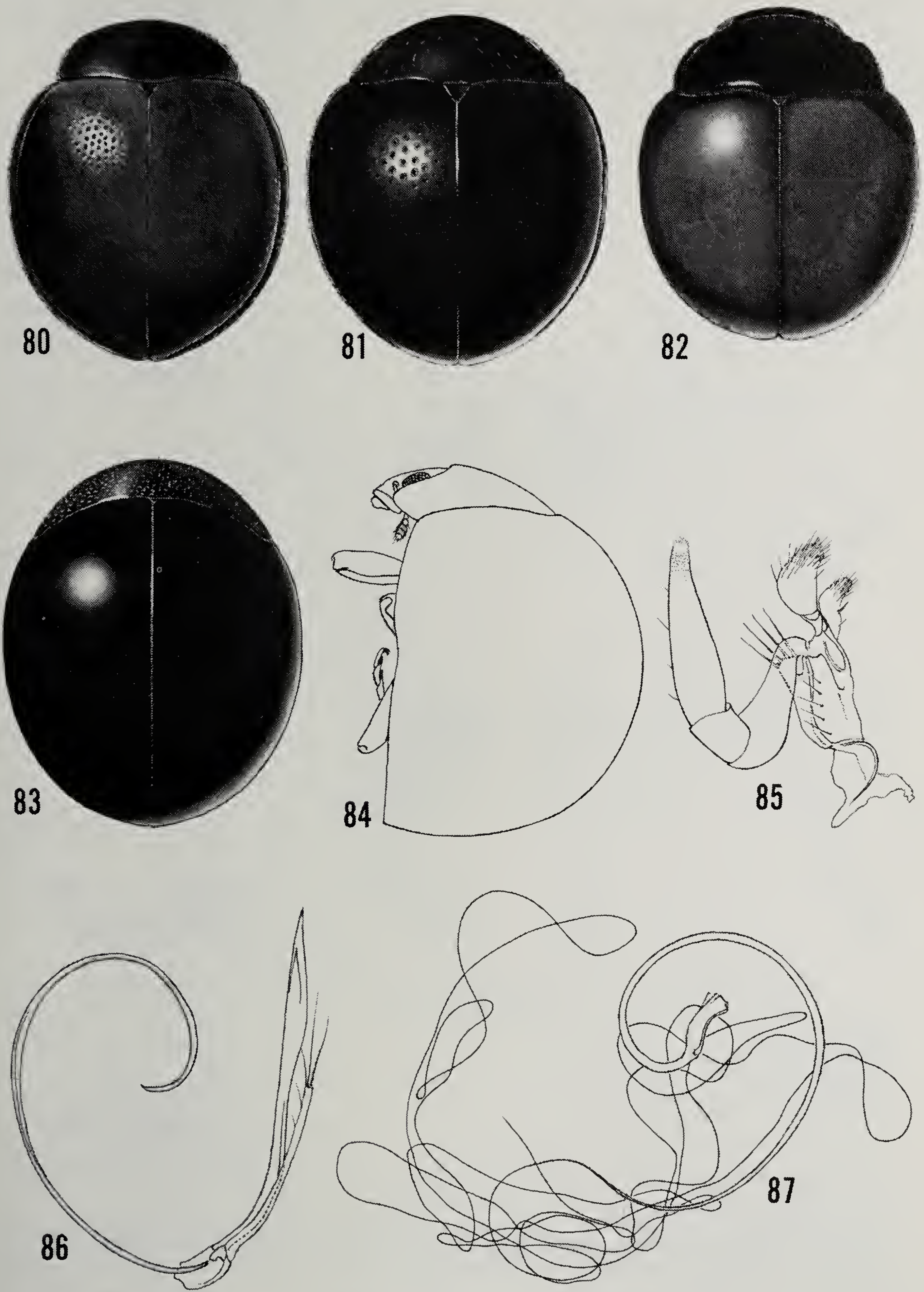
The generic name is a Latin noun referring to the convex, rounded form, gender is feminine.

KEY TO SPECIES OF *Glomerella*

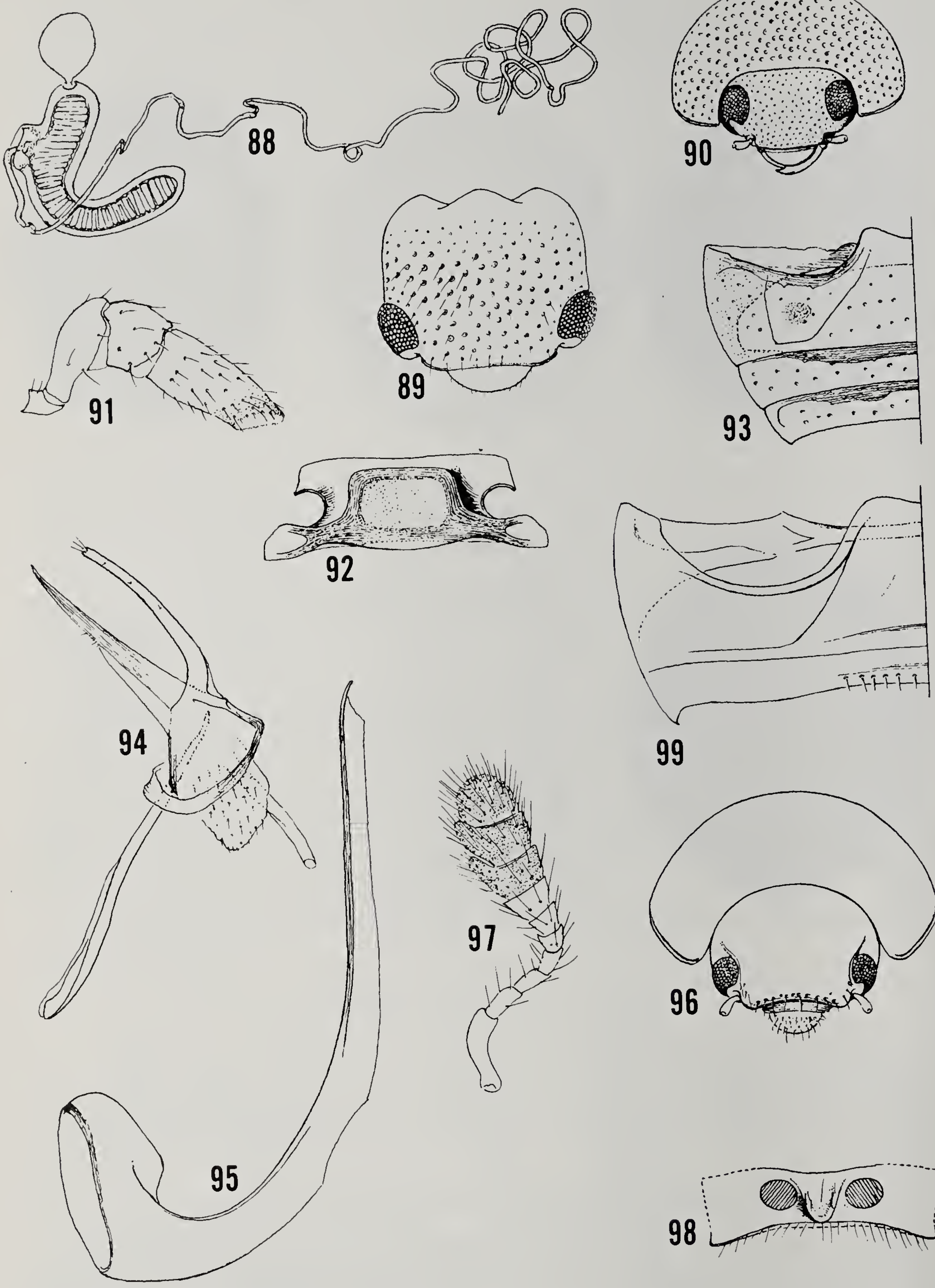
1. Clypeus with anterolateral angle produced (fig. 102); Brazil .... *G. perconvexa*, n. sp.
1′. Clypeus with anterolateral angle not produced (fig. 103); Colombia .... *G. gnoma*, n. sp.

Glomerella perconvexa Gordon, **new species**

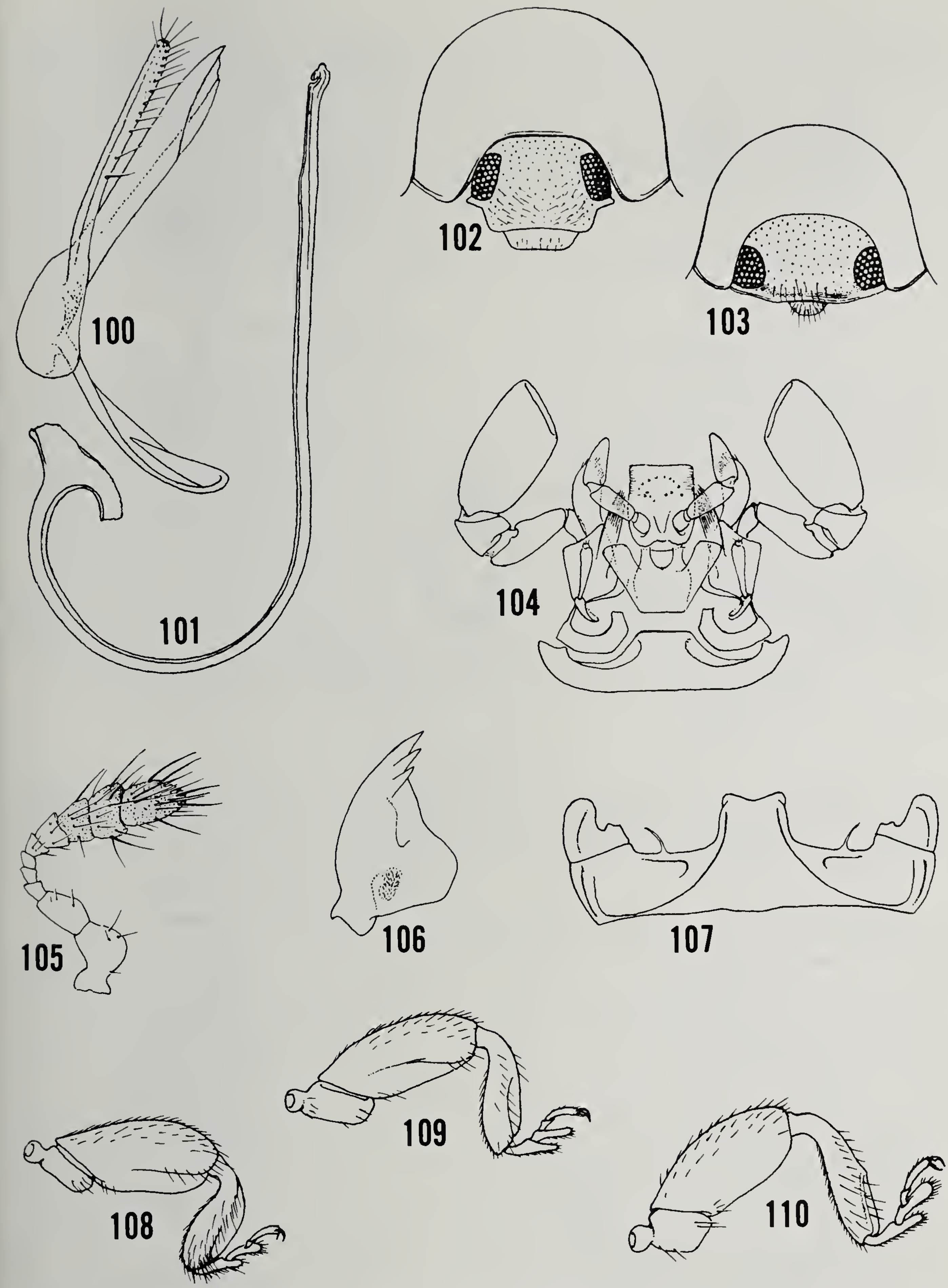
Holotype.—Female, length 1.50, greatest width 1.30 mm. Form round, extremely convex, forming half an oval in lateral view (fig. 84). Color piceous, nearly black; pronotum and most of head dark reddish piceous; clypeus, legs, epipleura, mouthparts, and antennae reddish brown; venter dark reddish brown except apical abdominal sterna paler reddish brown. Head with anterior clypeal border weakly emarginate medially, clypeal angle produced, rounded (fig. 102); surface feebly shiny, strongly reticulate, coarsely punctured, punctures separated by less than to twice a diameter, very short, sparse pubescence present. Pronotum feebly shiny, strongly reticulate, coarsely and densely punctured, punctures separated by a diameter or less, very short sparse pubescence present. Elytron smooth, polished, punctures extremely fine, nearly invisible, widely separated, some extremely fine, sparse pubescence present. First abdominal sternum with postcoxal line incomplete, abruptly bent upward at apex (fig. 107). Genitalia with spermathecal capsule strongly curved, accessory gland present, infundibulum long, slender (fig. 111).



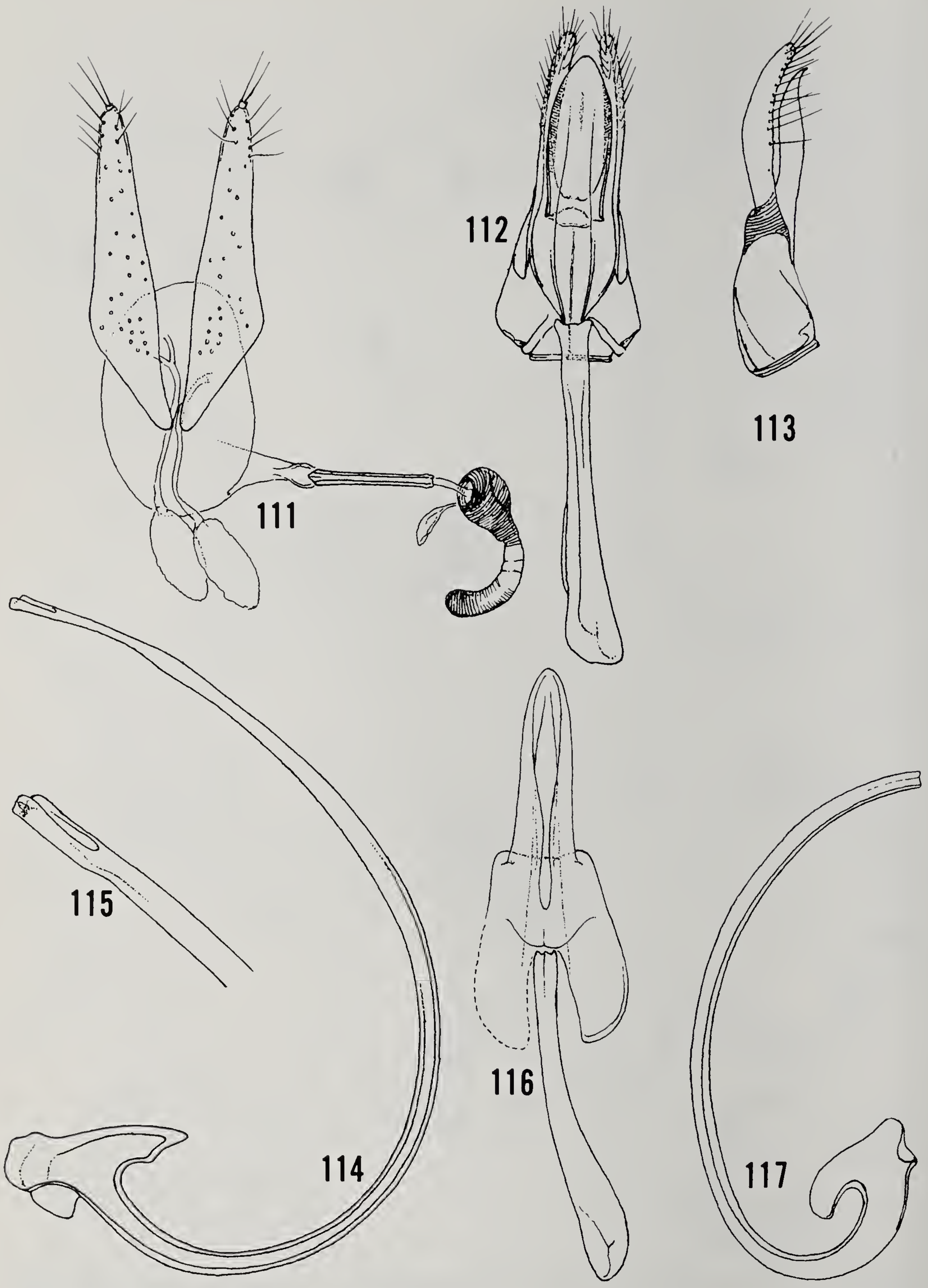
Figs. 80-87. Figs. 80-83, habitus views: 80, *Nexophallus lindemanni*; 81, *Nesina amazonia*; 82, *Neotina cariba*; 83, *Glomerella perconvexa*. Figs. 84-87: 84, lateral view, *Glomerella perconvexa*; 85, maxilla, *Nexophallus semiglobus*; 86, 87, male genitalia, *Nexophallus lindemanni*.



Figs. 88-99. Fig. 88, spermatheca and sperm duct, *Nexophallus lindemanni*; 89, head, *Nexophallus lindemanni*. Figs. 90-95, *Nesina amazonia*: 90, head; 91, apical segment of maxillary palpus; 92, prosternum; 93, abdomen; 94, 95, male genitalia. Figs. 96-99, *Neotina cariba*: 96, head; 97, antenna; 98, prosternum; 99, abdomen.



Figs. 100-110. Figs. 100, 101, male genitalia, *Neotina cariba*. Fig. 102, head, *Glomerella perconvexa*. Fig. 103, head, *Glomerella gnoma*. Figs. 104-110, *Glomerella perconvexa*: 104, mouthparts; 105, antenna; 106, mandible; 107, first abdominal sternum; 108, anterior leg; 109, middle leg, 110, hind leg.



Figs. 111-117. Figs. 111-115, *Glomerella perconvexa*: 111, female genitalia; 112-115, male genitalia. Figs. 116, 117, *Glomerella gnoma*, male genitalia (parameres broken),

Allotype.—Male, similar to female in all respects except sexual characters. Phallobase shorter than trabes, basal lobe sinuate in lateral view, shorter than paramere (figs. 112, 113); sipho as in figs. 114, 115.

Type-material.—Holotype, Brazil, Rio de Janeiro, Campo Grande, July 31, 1957. P. A. Berry collector (USNM 73784). Allotype, Brazil, Sao Paulo, Campinas, F. C. Camargo. Paratypes, 18: 3, same data as holotype; 6, Brazil, Rio de Janeiro, IV-14-39, P. A. Berry, on bamboo scales; 3, Brazil, Rio de Janeiro, II-7-39, K. A. Bartlett, on citrus scales; 2, ex. Brazil, intercepted at Puerto Rico, 27-1-1968; 4, "Brass.", Sammlung Cl. Müller (USNM) (ZSBS).

Remarks.—The specific name is a Latin adjective meaning extremely convex.

Glomerella gnoma Gordon, **new species**

Holotype.—Male, length 1.16 mm, greatest width 0.82 mm. Descriptions as for *perconvexa* except form more extremely convex dorsally, slightly flattened laterally; anterior margin of clypeus nearly truncate, anterolateral angle not produced (fig. 103); punctures on elytron distinctly visible, separated by 1 to 2 times a diameter, lateral border with margin thickened, sinuate medially. Genitalia with basal lobe slender, slightly curved (fig. 116); parameres lost; sipho as in fig. 117 (apex lost).

Type-material.—Holotype, Colombia, Magdalena, Rió Frio, Darlington (MCZ).

Remarks.—This species is known only from the holotype. It is clearly congeneric with *perconvexa* but quite distinct in having the strongly gibbous form, anterolateral angle of clypeus not produced, thickened lateral border of the elytron, and distinctly visible elytral punctures.

The specific name is a Neolatin noun referring to the small size.

PHYLOGENY

The methods I use for reconstructing a phylogeny are essentially those of Hennig (1966). No further discussion should be necessary because many recent authors have applied these methods and have explained the use of them to the point of redundancy.

There is what I consider an unfortunate tendency on the part of many modern systematists and associated members of the scientific community to dismiss out of hand the importance of any taxonomic work that does not have a phylogenetic discussion per se. This attitude has led to a proliferation of such discussions in situations where they are unnecessary because origins and relationships are patently clear or because the available data are not sufficient to allow significant phylogenies to be reconstructed. If one wishes to indulge in such mental gymnastics, then it should be sufficient that he do so, but he should not necessarily expect it of others. There are certainly many problems in systematics where a phylogenetic exercise serves as a valuable tool to aid in the resolution thereof. If the problem at hand lends itself to phylogenetic interpretation, then such an interpretation should be included. Important contributions to evolutionary theory and the probable past history of organisms involved can be derived through use of phylogenies, but the simple presence or absence of such a section in a taxonomic paper should have no bearing on the scientific merit of that paper.

In spite of, or perhaps because of, the preceding statements, I present a discussion of the phylogeny of the New World Sticholotidinae. I believe that, in this case, it is of some value.

Sasaji (1968) considered the Sticholotidinae the most primitive subfamily of Coccinellidae, with the ancestral character states of the common ancestor of living Sticholotidinae to include the following: narrow junction between the mentum and submentum; broad and compact articulation of the meso- and metasterna; metendosternite with broadly separated anterior tendons; flat ninth sternum of the male; larvae wth very short antennae; pointed apex of maxillary palpus; flat apical setae of tibiotarsi; and body wall without waxlike exudation or setose spines. Additional probable ancestral character states are listed in table 1.

Suspected phylogenetic relationships are summarized in fig. 118, and derived character states used to support these relationships are indicated by numbers in table 1. In the figures derived character states are indicated by black dots, and in multi-state characters the most derived state is indicated by a prime.

TABLE 1. Characters and character states used in phyletic analysis of Sticholotidinae.

	Character State	
Character	Ancestral	Derived
(1) Anterior portion of head	projecting	not projecting
(2) Basal segment of maxillary palpus	minute	large
(3) Apical segment of maxillary palpus	slender, always strongly narrowed	broad, conical or slightly narrowed
(4) Basal segment of labial palpus	inserted terminally	not inserted terminally
(5) Pronotum	with anterolateral line	without anterolateral line
(6) Prosternum	not concealing mouthparts	concealing mouthparts
(7) Prosternum	with anterior lobe	without anterior lobe
(8) Intercoxal process of prosternum	slender	broad, T-shaped
(9) Tibiae	not angulate	externally angulate
(10) Number of abdominal sterna	six	five
(11) Dorsal surface	strongly pubescent	glabrous or with insignificant pubescence

TABLE 2. Characters and character states used in phyletic analysis of *Scotoscymnus*.

	Character State	
Character	Ancestral	Derived
(1) Antenna	scape 7-segmented club 2-segmented	scape 9-segmented club with 1 segment
(2) Humeral callus	present	absent
(3) Elytral ridge	present	absent
(4) Wings	present	absent
(5) First abdominal sternum	with 2 pits	with 1 pit without pit (′)
(6) Tarsi	with 4 obvious segments	with third segment reduced

Ancestral Sticholotidinae differentiated into 2 stocks, the tribe Sukunahikonini on one hand and Microweisini, Serangiini, and Sticholotidini on the other. The first major dichotomy is based on the intercoxal process of the prosternum which is T-shaped and broad in the derived condition, slender, not T-shaped in the ancestral condition. The supporting character of strong dorsal pubescence (ancestral) or lack of pubescence (derived) is of less value because the presence of some pubescence has either been retained or has evolved independently in some members of the other lineages.

The derived condition of the abdomen having 5 visible sterna was developed by the sticholotine-serangiine lineage and is not repeated elsewhere in the phylogeny. Other derived characters supporting this dichotomy are the lack of an anterior pronotal line and the lack of an anterior prosternal lobe.

The derived character states of the Serangiini are the completely concealed mouthparts and externally angulate tibiae. The projecting head, type of antennal club, and form of the maxillary palpus are ancestral states shared with the Microweisini and Sukunahikonini. This reconstructed phylogeny points out the strong differences between modern representatives of the Sticholotidini and the Sukunahikonini. Zoogeographic data suggest an ancient split which almost certainly took place prior to the separation of South America and Africa at the close of the Cretaceous (65 million years ago).

The reconstructed phylogeny of species taxa of *Scotoscymnus* is shown in fig. 119, and the principal data used are listed in table 2. The first dichotomy in the phylogeny relects the differentiation of *S. pygmaeus* from the remainder of the genus. The presence of a distinct third tarsal segment is a strong ancestral character and I have also considered the presence of abdominal pits to be an ancestral character state. However, I have no solid reason to so consider the latter state except that lack of pits is a reduction and the most ancestral of the remaining lineages in the genus (*stephensi* lineage) has species with abdominal pits present.

TABLE 3. Characters and character states of the tribe Microweisini.

Character	Character State	
	Ancestral	Derived
(1) Head	not concealed beneath pronotum	concealed, partially or entirely
(2) Head	extremely elongate	not extremely elongate
(3) Eyes	small	large
(4) Eyes	coarsely faceted	finely faceted
(5) Maxillary palpus (apical seg.)	slender, elongate	broad, short
(6) Antenna	scape, 7-segmented club 3-segmented	scape 6-segmented, club 3-segmented; scape 7-segmented, club 2-segmented
(7) Prosternum	strongly lobed	weakly lobed
(8) Elytra	pubescent	glabrous
(9) Tarsus	cryptotetramerous	trimerous

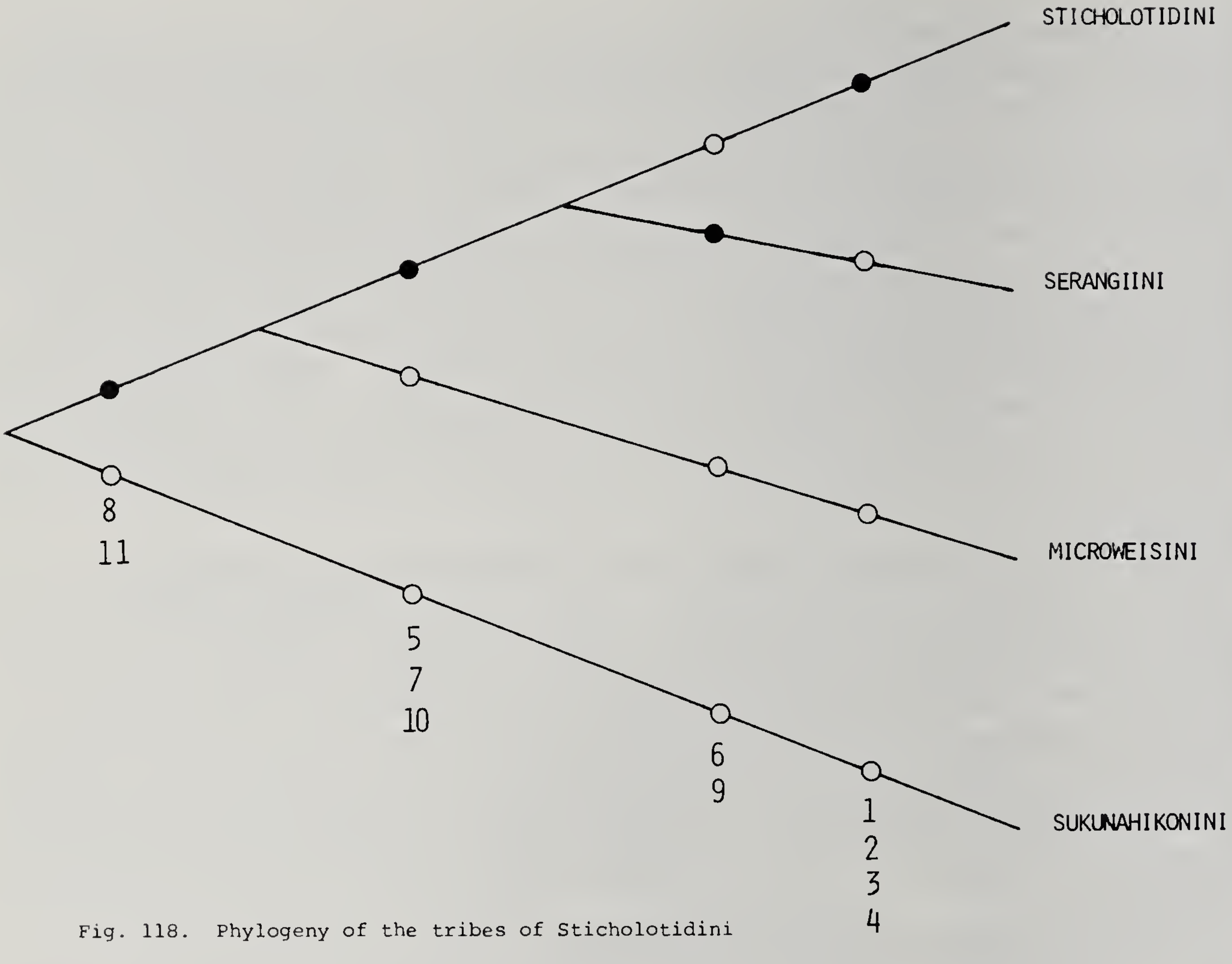


Fig. 118. Phylogeny of the tribes of Sticholotidini

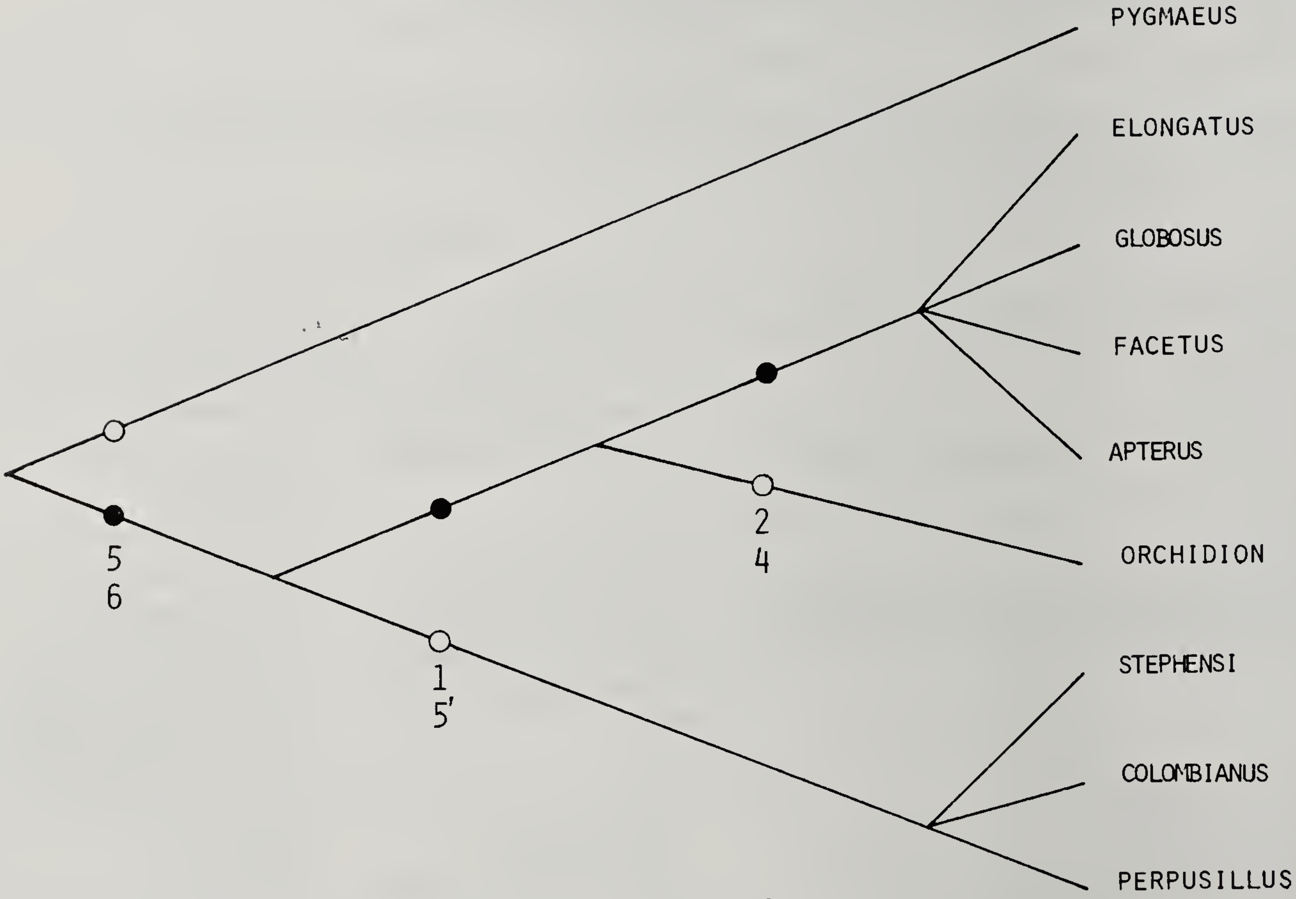


Fig. 119. Reconstructed phylogeny of species taxa of Scotoscymnus.

The derived character states of 9-segmented antennae and lack of abdominal pits characterize the *elongatus* lineage and split it from the *stephensi* lineage. These derived character states are shared by *S. orchidion*, but *S. orchidion* is split from the *elongatus* lineage because it possesses the ancestral winged condition. The *elongatus* lineage (4 species) and *stephensi* lineage (3 species) are not further defined in the phylogeny because of a lack of significant characters.

I have not prepared a phylogenetic scheme for the Microweisini because significant groupings are not possible with the characters available for use. Table 3 lists the available characters and character states, and fig. 120 is a character state matrix for this tribe. *Microcapillata* is the only lineage that clearly splits from the rest, possessing the following ancestral character states: head extremely elongate; eyes small; eyes coarsely faceted; elytra pubescent; tarsi cryptotetramerous. *Sarapidus* has the ancestral character states of cryptotetramerous tarsi, head not concealed beneath pronotum, and 10-segmented antennae, but the state of each of the other characters is derived. I consider *Microcapillata* and *Sarapidus* the most primitive genera in the tribe. The remainder of the genera are very similar in characters and character states. *Stictospilus* has the ancestral states of long dorsal pubescence and a pronounced prosternal lobe so I consider it somewhat primitive. *Coccidophilus, Microweisea,* and *Pseudosmilia* form a group because nearly all of the characters are derived with *Microweisea* retaining the ancestral 10-segmented antennae. I do not place *Gnathoweisea* with this latter group because it has the ancestral state of small, widely separated eyes and the derived state of partially concealed head. The character states of *Nipus* are almost equally divided between ancestral and derived. The strongly lobed prosternum and 10-segmented antennae I consider ancestral and the completely concealed head derived.

	1	2	3	4	5	6	7	8
1	○	○	○	○	○	○	●	●
2	○	●	●	●	●	●	○	○
3	○	●	●	●	●	●	○	●
4	○	●	●	●	●	●	●	●
5	○	●	○	○	○	○	○	○
6	○	○	●	○	●	●	●	○
7	●	●	○	●	●	●	●	○
8	●	●	○	●	●	●	●	●
9	○	○	●	●	●	●	●	●

Fig. 120. Character state matrix for the tribe Microweisini. Numbers on the side refer to the characters as listed in Table 3. Numbers across the top refer to the genera in the order in which they appear in the text.

The Sticholotidini are represented by only 4 genera in the New World and any attempt at reconstructing a phylogeny without using the numerous Old World genera would not be significant. The following comments apply only to the New World fauna. I consider *Nexophallus* as probably the most primitive genus because the slender, tapered apical segment of the maxillary palpus, widely separated eyes and flat prosternum are ancestral character states. Derived character states include complete postcoxal lines and complex male genitalia. *Nesina* is similar to *Nexophallus* in most respects but possesses the additional derived states of a short, expanded apical segment of the maxillary palpus, a raised rectangular area on the prosternum, and narrowly separated eyes. Character states in *Neotina* are derived except for the incomplete postcoxal lines and widely separated eyes which are ancestral. *Glomerella* possesses characters that I would normally consider ancestral but here are apparently derived as adaptations to the mode of existence. These are the presence of cavities on the ventral suface for the legs and presence of a small anterior lobe on the prosternum. In addition, the derived character states include the broad apical segment of the maxillary palpus; shiny, convex dorsal surface; and reduced scutellum. The widely separated, coarsely faceted eyes represent an ancestral character state. I consider *Glomerella* the most advanced of the New World genera of Sticholotidinae.

ZOOGEOGRAPHY

The subfamily Sticholotidinae is best developed and most diverse in the Old World. How many lineages exist in the Old World is open to question, but based on genera I have examined, probably not more than 6 or 7. Four of these lineages, or more than half, are represented in the Western Hemisphere. The modern distribution pattern indicates that the ancestral stock of this subfamily was ancient, and indeed it probably was the base of the family Coccinellidae. The modern species form more or less isolated groups (genera), many of them monobasic and often possessing quite different facies; this is the typical pattern of a primitive lineage having extant survivors.

The genus *Scotoscymnus* is the only Western Hemisphere representative of the Sukunahikonini and is known from Mexico to Colombia. I find it difficult to explain the modern distribution of this genus because it is apparently pantropical; species are known from the Belgian Congo, Java, Mauritius, and Micronesia as well as the Western Hemisphere (fig. 121). Of the 19 known species, 8 occur on the Micronesian islands and 9 in the Western Hemisphere. Each species is quite distinct, but I find it impossible to place them in more than one genus. How then can the present distribution be accounted for? This apparently widely disjunct distribution may be an artifact of collecting, but even if this is so, an explanation is still difficult. *Scotoscymnus* is very probably the most ancient of the extant genera of Coccinellidae, and the present distribution of the species is the result of continental drift. The ancestral stock of this lineage was probably spread throughout what is now Africa and South America prior to the Lower Cretaceous. After fragmentation of the continents massive extinction must have occurred in both hemispheres through the Miocene and Pliocene. Modern remnants exist as indicated in figure 121, limited to northwestern South America, Central America, and Mexico in the Western Hemisphere. The most primitive of the extant genera of the Sukunahikonini (*Orculus* Sicard) is known from coastal West Africa (Sierra Leone and Principe Island) which may indicate that this is the area of origin of the ancestral stock, but this is a matter of pure speculation. The presence of a number of species on the Micronesian islands indicates that these beetles are capable of rapid dispersal and speciation on island chains. Gressitt (1954) gives the age of the older Micronesian islands as Miocene or before but states that most of the islands are less than 10 million years old which would make them of Pliocene or Pleistocene age. Truk and Ponape are said to have been formed in the Eocene and Oligocene (25-40 million years ago). It is of interest that the majority of the described Micronesian species are found on these older islands. The Micronesian fauna may be the result of invasion from the mainland of southeast Asia, or it may be the result of transportation by early man. Plants infested with the host scales and predators could have been transported across the Pacific islands. If so, I would expect that other Pacific islands have members of this genus inhabiting them. In view of the facts that no New World species of *Scotoscymnus* have been described prior to this paper and that the Micronesian species were not described prior to 1965, I believe the distribution of this genus is far from completely defined. The salient facts that emerge so far are that the genus is pantropical and is primarily associated with the Pacific Ocean, its islands, and the corresponding areas of Central America and Colombia.

The tribe Microweisini differs from the other 3 tribes discussed herein in that it is primarily New World in distribution with 2 monotypic genera in the Old World. Two of the 3 primitive genera of New World Microweisini (*Sarapidus* and *Stictospilus*) are apparently strictly Chilean and this would indicate the presence of the ancestral stock in southern South America. I judge that the ancestral stock of this lineage was present in Gondwanaland

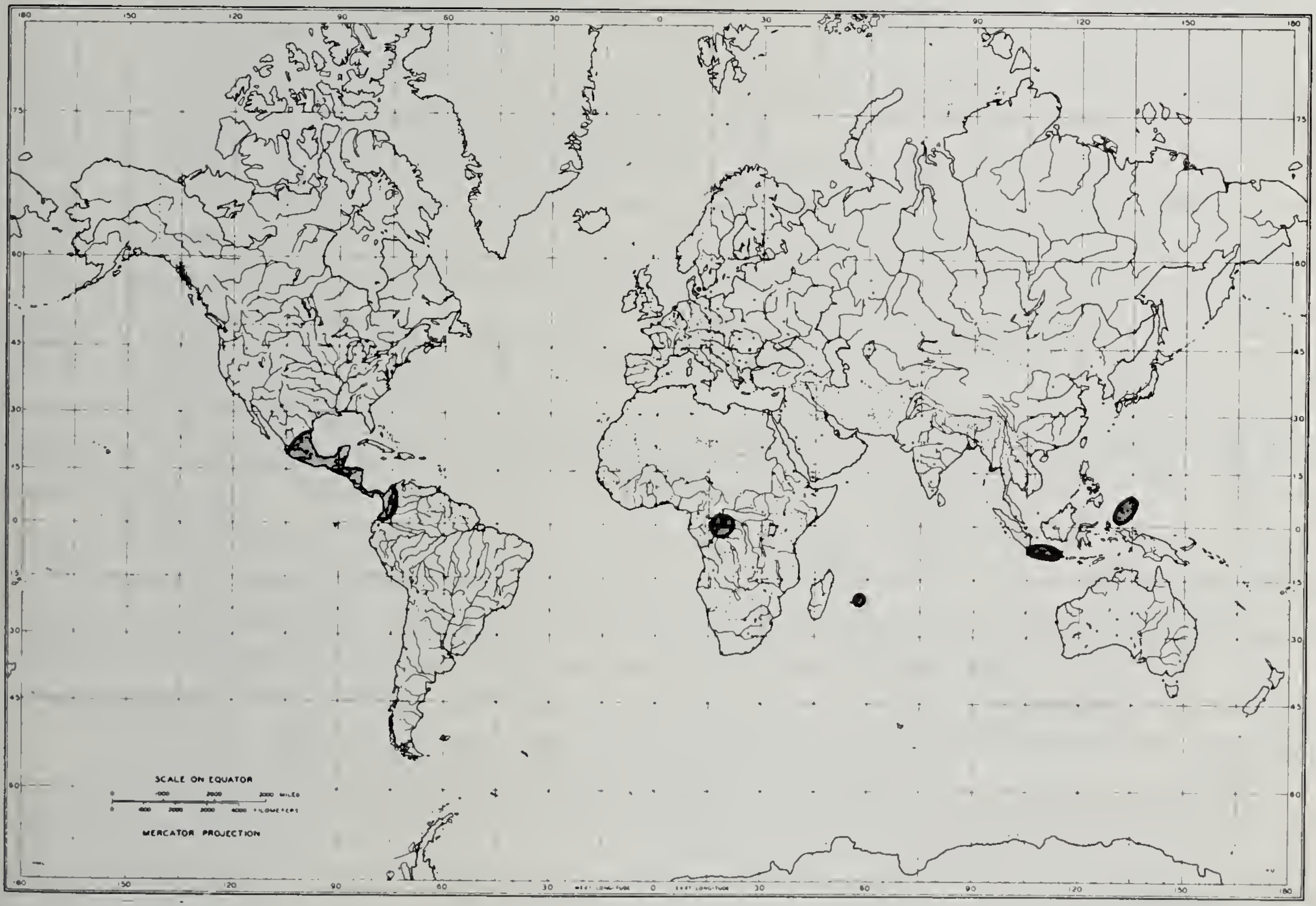


Fig. 121. The known distribution of members of the genus *Scotoscymnus*.

before fragmentation began 125 million years ago in the Lower Cretaceous (Raven and Axelrod 1975). The modern distribution in the Western Hemisphere is the result of radiation during the ensuing eras. The presence of a single modern genus (*Dichaina*) in Australia leads me to believe that extinction probably occurred in Australia during the Tertiary when that continent changed its latitude (Main, 1976) and in so doing became mostly a desert continent. In South America climatic conditions changed during the Late Miocene and Pliocene, particularly in the south, became increasingly dry and cold (Solbrig 1976). This led to isolation, extinction, and migration of ancestral Microweisini. According to Savage (1974) the final link between South America and Central America was established in the Early Pliocene. From that time on free overland interchange of organisms has been possible. I presume the ancestral stock of the modern genera of Microweisini presently occurring north of the Isthmus migrated north from South America during the Pliocene and early Pleistocene. Radiation occurred during and since the Pleistocene, resulting in the present array of genera and species.

The genus *Delphastus* represents the tribe Serangiini in the New World. This is a tropical genus with only 2 species extending into the north and south temperate regions. The ancestral stock from which the modern genera of Serangiini arose probably originated in what is now eastern Asia or Australia, based on the present distribution of genera. There seem to be 2 possible explanations for the presence of *Delphastus* in the New World. One is that the ancestral lineage entered North America via the Bering Land Bridge in the early Tertiary when warm temperate or tropical conditions prevailed. Movement to the south and east must have occurred with some extinction in the northern regions as climatic changes transpired during and after the Oligocene. The fact that *Delphastus* is presently found in tropical and warm temperate regions would seem to substantiate this theory. Savage (1974) indicated that direct land connection between Central and South America took place in the Pliocene and migration into South America would have taken place in late Pliocene and Pleistocene. The other possible explanation involves plate tectonics. Geologic evidence indicates that South America was directly connected with Africa and, via Antarctica, with Madagascar, India, and Australia (Raven and Axelrod 1975) during the Middle Cretaceous. Separation began in the Lower Cretaceous but opportunities for migration across islands between South America and Australia existed until Early Oligocene. Because almost exactly parallel situations presently exist in regard to the number and distribution of species in the Northern and Southern Hemispheres, it is difficult to indicate which of the 2 possibilities discussed is the most probable. Australia presently has a sizeable fauna of Serangiini (genus *Serangium*) and what evidence is available tends to point toward the southern route of migration. As in North America, changing climatic factors have prevented the occurrence of extant species or genera in southern South America. Information on the zoogeography of the Aleyrodidae would be helpful in analyzing the present distribution of the Serangiini, but this is not available.

The tribe Sticholotidini has many modern genera and species in the Old World but is known from only 4 genera and 7 species in the Western Hemisphere. The affinities of the genera *Nexophallus* and *Nesina* are with the Old World *Sticholotis* and *Lotis*. *Sticholotis* occurs from Japan and

Formosa to Australia and there are more than 50 described species in the genus. *Lotis* and related genera are all African with fewer than 20 described species. The present distribution pattern indicates that the New World genera are remnants descended from an ancestral stock left behind when South America and Africa separated during the Cretaceous. The depauperate fauna presently existing in the New World would seem to indicate that extensive radiation did not take place or that a great deal of extinction has taken place. The presence of a single modern genus in Cuba tends to lend credence to the latter alternative. This genus is probably descended from ancestral stock that reached Cuba from South America prior to the Pliocene with no extant survivors remaining on any nearby land mass.

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NEW SYNONYMY AND STATUS CHANGES IN THE GENUS *PLEOCOMA* LECONTE (COLEOPTERA: SCARABAEIDAE)

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ABSTRACT

The status of *Pleocoma staff* Schaufuss is clarified, with *P. ulkei* Horn reduced to synonymy. The replacement names *P. edwardsii* LeConte and *P. adjuvans* Crotch are suppressed as nom. nov. pro *staff*. *Pleocoma remota* Davis is synonymized with *P. oregonensis* Leach, and the putative Utah localities for the genus are invalidated. *P. badia* Fall is expanded to include *P. hirsuta* Davis as a subspecies; *P. venturae* Linsley and *P. nitida* Linsley are placed in synonymy with *P. badia hirsuta*. Phenotypic variation and intergradation are discussed for each population. *P. lucia* Linsley is placed as a subspecies of *P. conjungens* Horn, and known biological information is summarized.

The scarabaeid genus *Pleocoma* LeConte, as currently recognized in the literature, includes 33 described species and 3 additional subspecies. Because of the relative rarity of specimens in collections, many of these forms were originally characterized from but one or a very few specimens, which generally precluded assessment of character variation and useful speculation on evolutionary relationships. Modern collecting methods, particularly the use of ultraviolet light, have greatly facilitated acquisition of series of male specimens. Most samples which were thought to represent geographically isolated entities have subsequently proven to be phenotype variants in widely distributed, somewhat polytypic populations. Increased knowledge of distribution and patterns of intrapopulational phenotypic variation has made possible a reassessment of taxonomic relationships in several species.

The status changes and synonymy proposed herein reflect the relationships of some of the more extensively sampled populations. These changes are presented prior to an anticipated comprehensive treatment of the genus in order to facilitate identification and incorporation of future discoveries.

Pleocoma staff Schaufuss

Pleocoma staff Schaufuss 1870:52; Rye 1874:283; Sharp 1875:206-207; Rye 1875:319; Horn 1888a:235; Horn 1888b:9, pl. 1, fig. 12; Ohaus 1909:430, t. 5; Davis 1935:31; Linsley 1938a:51-52; Linsley 1938b:99, 103.

Pleocoma adjuvans Crotch 1873:58 (nom. nov. pro *staff* Schaufuss); Sharp 1875:206-207; Rye 1875:319.

Pleocoma edwardsii LeConte 1874:83 (nom. nov. pro *staff* Schaufuss); Davis 1935:33, pl. 1, fig. 13; Linsley 1938a:50-51; Linsley 1938b:99, 101; Linsley 1941:150; Linsley 1957:102.

Pleocoma staffa Sharp 1875:207 (emend. pro *staff* Schaufuss); Rye 1875:319.

Pleocoma ulkei Horn 1888a:234; Horn 1888b:9, pl. 1, fig. 11; Leach 1933:184; Davis 1935:34, pl. 1, fig. 8; Linsley 1938a:50-51; Linsley 1938b:100-104. **New Synonymy.**

As evident from the references cited above, considerable confusion has arisen with regard to the nomenclature and more recently (Davis 1935) the true identity of this species. Crotch (1873) proposed *P. adjuvans* as a replacement name for the offensive name "*staff*" Schaufuss, but the name was not accepted by LeConte (1874) because it was proposed in a checklist. Consequently, he proposed *P. edwardsii* as a replacement name for *P. staff,* which he considered scientifically inadmissible due to its tactless political etymology. LeConte made it clear that he was not describing a new taxon, but rather redescribing one which, by his own admission, had been adequately and recognizably characterized by Schaufuss. He did, however, select a holotype for his replacement name (*P. edwardsii*) other than the original Schaufuss type. Subsequent authors (Sharp 1875; Horn 1888a & 1888b; Ohaus 1909), recognizing the impropriety of LeConte's action, continued to use the name *P. staff.* Davis (1935), in his revision of the genus, gave full species status to both *P. staff* and *P. edwardsii,* his differentiation based primarily upon the supposedly densely pubescent scutellum of *P. staff* (as opposed to the nearly glabrous scutellum of *P. edwardsii*). The holotype of *P. staff* was not available to Davis except by indirect comparison, and he therefore relied upon an incorrect translation of Schaufuss' remarks regarding this character. Although Davis did describe the scutellum of *P. staff* as being "very sparsely hairy" (based upon notes sent to him regarding the holotype), he added, "This hair has undoubtedly been rubbed off, since Schaufuss specifically mentions that the scutellum is hairy." In the discussion following the original description of *P. staff,* Schaufuss states (in translation): "The anterior half of the scutellum is covered with dense long yellow hairs; the central and posterior parts have lightly impressed, scattered punctures." The "anterior half" to which Schaufuss alluded was undoubtedly the visible portion of the mesonotal surface, which is densely punctate-pubescent in all species of *Pleocoma.* The pubescence of the holotype is very matted, but the scutellum is not at all obscured and is in fact glabrous and nearly impunctate. In general aspect the holotype is essentially identical to specimens at hand from Grass Valley and North San Juan, both in Nevada County. Among the 277 male specimens of *P. staff* examined during this study, the scutellum varies from glabrous and impunctate to lightly punctate-pubescent medially.

Horn (1888a & 1888b) originally characterized *P. ulkei* from a unique male labelled "Utah." He distinguished it from the LeConte type of *P. edwardsii* (= *P. staff* Schaufuss) by the relative shape of the posterior pronotal angles and the slightly differing lengths of the fourth antennal segments. These characters are randomly variable throughout the material examined and cannot be used to distinguish populations. Davis (1935) considered *P. ulkei* to be a species distinct from *P. staff,* although he stated that he could scarcely separate it from *P. edwardsii,* adding, "I am inclined to regard them as identical, but in view of the fact that the type of *edwardsii* lacks the terminal joints of the antennae a positive statement to that effect would be inadvisable." The characters enumerated by Davis as separating *P. ulkei* from *P. edwardsii* are similar to those given by Horn and are neither species diagnostic nor statistically valid. The holotype of *P. ulkei* most closely resembles specimens in my series from Nevada City, Nevada County, and may well have been collected somewhere in that general area.

Type Localities: *P. staff,* "California mer"; *P. edwardsii,* not given by LeConte ("California" fide Horn, 1888b); *P. ulkei,* "Utah".

Material Examined: 277 males, 47 females; CALIFORNIA: *Shasta County*: Redding; *Yuba County*: Brownsville; *Butte County*: DeSabla, Chico, Forest Ranch, Paradise; *Nevada County*: Nevada City, North San Juan, Grass Valley (Fig. 1).

Types Examined: *P. staff, P. edwardsii, P. ulkei.*

Pleocoma oregonensis Leach

Pleocoma oregonensis Leach 1933:186; Davis 1935:17; Linsley 1938b:99, 102; Ellertson 1954:938; Ellertson 1955:13-15; Ellertson 1956:431; Ellertson 1958:98; Ellertson & Ritcher 1959:1-42; Ellertson 1964:171-173; Fellin & Ritcher 1967: 251-263; Hatch 1971:437.

Pleocoma remota Davis 1934a:23; Davis 1935:8, pl. 1, fig. 9; Linsley 1938b:100, 102; Smith 1886:33 (as *Pleocoma behrensi* LeConte). **New Synonymy.**

Although the respective type specimens of *P. oregonensis* and *P. remota* were collected many years prior to being described, the dates of publication for the names are only a few weeks apart. *Pleocoma oregonensis* has priority, which is fortunate as the species has been so recorded in numerous publications. It is thus far known only from north-central Oregon (Jefferson, Wasco and Sherman counties). The holotype of *P. remota* is identical in all important respects with the type of *P. oregonensis.* Davis (1935) had not seen specimens of *P. oregonensis,* and he attempted to differentiate it from *P. remota* solely by the comparative lengths of the third antennal segment. The second couplet of Davis' key separates *P. remota* from all other "4-jointed" species by having the third segment "more than three-fourths as long as first," whereas *P. oregonensis* is grouped with species having the third segment "three-fourths or less than three-fourths as long as first." However, Davis' original and subsequent revisional descriptions of *P. remota* cite the third antennal segment as "seven-tenths as long as first joint," which is of course, less, not more, than three-fourths. Regardless of this simple error, it is now clear that relative proportions of *Pleocoma* antennal segments are often subject to considerable variation and can rarely be utilized as species-diagnostic characters. In the large series of *P. oregonensis* examined, the length of the third antennal segment varies from less than 1/2 to more than 3/4 as long as the scape.

The newly established synonymies of *P. remota* with *P. oregonensis* and *P. ulkei* with *P. staff* eliminate the putative Utah localities which have unnecessarily complicated attempts to explain distributional and evolutionary patterns in the genus.

Type Localities: *P. oregonensis,* Wasco, Oregon; *P. remota,* "Utah".

Material Examined: 267 males, 35 females; OREGON: *Jefferson, Wasco* and *Sherman Counties,* numerous localities.

Types Examined: *P. remota, P. oregonensis.*

Pleocoma badia Fall

Pleocoma badia Fall as herein redefined is a complex of closely related geographical segregates, differing by male elytral coloration and relative antennal or pronotal character states. Individual patterns of character variation occur within each sample, and although some specimens appear to be quite distinctive, they invariably represent intrapopulational phenotype extremes. Additionally, character variation within a sample is frequently transitional with other comparable samples, leading to areas of phenotypic intergradation or polytypy. Material at hand suggests a conservative, single-species treatment of the population segregates previously named *P. badia* Fall, *P. hirsuta* Davis, *P. venturae* Linsley, and *P. nitida* Linsley.

Pleocoma badia badia Fall, **New Status**

Pleocoma badia Fall 1917:15; Davis 1916:11-12 (habit note prior to original description); Davis 1918:116-118; Davis 1924:48; Davis 1935:26, pl. 1, figs. 1, 17; Linsley 1945:112.

Males of *P. badia badia* Fall are remarkably constant in the relatively large amount of material now available for study. Elytral coloration is uniformly light reddish-brown, while pronotal coloration ranges from reddish-brown to piceous. Pronotal pubescence and associated coarse punctation are confined to the antemedian impression, which is usually narrower than the head. Antennal segment 3 is simple, elongate, and subcylindrical; segment 4 is transverse, angulated anteriorly or with a short lamella; segment 5 has a lamella from 2/3 to 4/5 as long as segment 6.

A recently discovered population of *P. badia,* extending along a ridgetop between Bear Divide and Newhall in Los Angeles County, represents a phenotypic cline between the nominotypical *P. badia* and *P. hirsuta.* Random samples of equal number were collected from two areas along an east-west transect, and males in each sample were arranged according to elytral coloration, from lightest to darkest. In the first sample, taken from 3 to 4 miles west of Bear Divide, 36% are within the narrow normal color range of typical *P. badia,* 24% within the normal color range of *P. hirsuta* and the remainder comprise a remarkably even gradient between the two. In the second sample, collected between 6.1 and 9.7 miles west of Bear Divide, only 8% are as light-colored as typical male *P. badia,* while 40% are within the range of "*hirsuta*;;. Most of the sample display a colorational continuum from rich reddish-brown to very dark chestnut-brown. Pronotal coloration is predominantly reddish in both samples, although piceous pronota may be found with all combinations of elytral coloration. The color of the body pubescence, normally a rather constant feature in the genus, ranges from golden to dull reddish-brown or light chocolate-brown. Golden is predominant, particularly among the paler specimens, with reddish or brown combining at random with integumental color, creating a mosaic of phenotypes. Structurally, these samples are within the normal ranges of *P. badia badia,* except that the antemedian pronotal impression is frequently more broadly convex.

Whether these samples actually represent an area of secondary subspecies contact between *P. badia badia* and *P. badia hirsuta* can only be established by further collection. Suitable localities east of Bear Divide should be surveyed to determine the distributional range of the nominate phenotype. It is possible that typical *P. hirsuta,* which is now known to be widespread and abundant throughout the foothills of the western San Gabriel Mountains, has only recently become established at the higher altitudes of the sample localities, and that phenotype instability is responsive to different environmental pressures. Reddish male populations of *P. badia* occur at considerably higher elevations than do the piceous populations, which suggests that there may be selection for a paler integument at higher altitudes. Significant vertical movement by any population of *Pleocoma* might well result in gradual chromatic changes, although in most insects, when movement is toward higher elevations, the changes would be expressed in melanism rather than albinism.

Pleocoma badia hirsuta Davis, **New Status**

Pleocoma conjugens var. *hirsutus* Davis 1934b:88-89; Davis 1935:29.
Pleocoma hirsuta, Linsley 1941:146-147; Ritcher & Baker 1974:480-494 (morphology).
Pleocoma nitida Linsley 1941:147-148; Hazeltine 1952:202; Hovore 1971:200-201. **New Synonymy.**
Pleocoma venturae Linsley 1945:110-111; Hovore 1971:200. **New Synonymy.**

Pleocoma badia hirsuta Davis (including population segregates previously named as *P. venturae* and *P. nitida*) differs from the nominotypical subspecies most consistently by the piceous coloration of the male elytra. Although some population samples have character tendencies which, at their extremes, appear to differ qualitatively, most of the structural characters have proven to be transitional between geographic segregates.

Within samples of "typical" *P. b. hirsuta* (from Newhall, 7 mi S Sandberg, Tujunga, La Crescenta, Glendale) most characters exhibit independent patterns of variation. The holotype of *P. b. hirsuta* is somewhat smaller and hairier than the norm, a condition represented by about 5% of any sample. Pronotal coloration ranges from entirely pale reddish to wholly piceous; the antemedian impression varies from feebly indicated to broadly convex; the coarseness of pronotal punctation and the pubescence are interrelated structures, varying from nearly absent to covering the entire discal surface. The relative pronotal dimensions and the extent of the basal angulation exhibit a broad spectrum of variation, with a tendency toward allometry. The greatest relative pronotal width is usually expressed in the largest individuals. Antennal ratios are essentially identical to those found in *P. b. badia.*

Material examined from the Santa Monica Mountains is very close phenotypically to samples from near the type locality, but with a characteristic tendency toward more robust, less pubescent pronota.

P. venturae was originally differentiated from *P. badia, P. hirsuta,* and *P. nitida* by the lack of coarse pronotal punctation-pubescence. In the 45 males examined (including the holotype and 27 paratypes), well over 1/3 have the antemedian impressions with significant numbers of larger, pubescence-bearing punctures. There is a tendency for slight reduction of the antennal formula, with occasional specimens having the lamella of segment 5 only 1/3 as long as that of segment 6. These tendencies are statistically insignificant, and are transitional between segregates. *P. venturae* is therefore considered a synonym of *P. badia hirsuta.*

Males of the *P. nitida* segregate exhibit the greatest number of characters extremes thus far seen in this subspecies. The pronotal median impression is usually very broadly convex, with coarse punctation-pubescence frequently distributed over the entire discal surface. The more shining integument, glabrous scutellum, sparsely hairy and broad pronotum of the holotype are inconsistent characters within the samples at hand, and generally are convergent with their counterparts in other geographical segregates. Antennal segment 4 is transverse, with a short projection or lamella up to 1/3 as long as that of segment 5, and segment 5 has a lamella from 2/3 to 4/5 as long as that of segment 6. Pronotal dimensions fall within the same basic numerical sets as those of "typical" *P. b. hirsuta,* measuring from scarcely more than twice as wide as long to nearly 2½ times as wide as long.

Material collected 6 miles NE of Santa Margarita, San Luis Obispo County, in 1970 and 1973 suggests that a certain amount of allochronic variation may occur among various generations. Specimens from 1973 have the dorsal integument more opaque, the elytra minutely alutaceous, and the antennal formulae confined to the lower values of the 1970 sample.

Females of *P. b. badia* and *P. b. hirsuta* cannot be differentiated constantly in series. The lone female examined of *P. nitida* is smaller than those of other segregates, has the pronotum barely wider than long (as opposed to distinctly wider than long in *P. b. badia* and "typical" *P. b. hirsuta*), and has the antemedian pronotal surface finely pubescent. If these differences prove constant in series, *P. nitida* may possibly represent a subspecies. In view of the extreme variability of the male phenotype in this subspecies, and the high percentage of character convergence between geographical segregates, it seems appropriate to regard *P. nitida,* along with *P. venturae,* as a synonym of *P. badia hirsuta.*

Type Localities: *P. badia,* Mt. Wilson, Los Angeles County; *P. hirsuta,* "between Lebec and Saugus, in Los Angeles County, California, in the Sierra Madre Mountains" (label data actually reads: "Ridge Route . . . 7 miles this side of the summit"); *P. venturae,* Squaw Flat, Sespe Canyon, Ventura County; *P. nitida,* (holotype) 1 mile S Atascadero, San Luis Obispo County, (allotype) 6 miles E Santa Margarita, San Luis Obispo County.

Material Examined: *P. b. badia*: 235 males, 95 females; CALIFORNIA: *Los Angeles County*: Mt. Wilson, Strawberry Peak, 3-4 miles W and 6.1-9.7 miles W Bear Divide; *b. hirsuta*: 211 males, 18 females; CALIFORNIA: *Los Angeles County*: Ridge Route, 7 miles S Sandberg, Newhall and vicinity, Placerita Canyon, Tujunga, La Crescenta, Glendale, and various localities throughout the western San Gabriel Mountains and the Santa Monica Mountains; *Ventura County*: Squaw Flat, 5 miles S Squaw Flat, Tar Creek (*venturae*); *Santa Barbara County*: "Santa Barbara" (1 female); *San Luis Obispo County*: 6 miles NE Santa Margarita (*nitida*) (Fig. 1).

Types Examined: *P. hirsuta, P. venturae, P. nitida.*

Pleocoma conjungens Horn

This species, as herein redefined, consists of two apparently allopatric population groups, occurring in the coastal mountain ranges of Santa Cruz and Monterey Counties, California.

Within the material examined from both populations, characters such as the shape of the ocular canthi, the relative proportions of the intermediate antennal segments and the dorsal outline of the pronotum express remarkably similar patterns of variability; population differentiation is therefore based primarily upon quantitative but consistent antennal characters. There is also a considerable difference in overall size between females of the two segregates, and available biological information seems to indicate a difference in larval food preferences.

The antennomeres of the two known population groups do not appear to be transitional, and, in the absence of geographically or phenotypically intermediate material, it seems best to consider them as representing two discrete subspecies.

Pleocoma conjungens conjungens Horn, **New Status**

Pleocoma conjugens Horn 1888a:234; Horn 1888b:7, pl. 1, fig. 10; Davis 1935:28, pl. 1, fig. 10; Linsley 1938a:54-55; Linsley 1938b:100, 101; Linsley 1941:145; Hazeltine 1950:188-189.

Males of *Pleocoma c. conjungens* exhibit considerable variation in the relative development of the intermediate antennal segments. Segment 3 is elongate, strongly angulated anteriorly at apical 1/3; segment 4 is usually transverse, angulated anteriorly or with a short projection (rarely simple); segment 5 has a lamella from slightly less than 1/3 to about 2/3 as long as that of segment 6. The holotype has the lamella of the antennal segment 5 somewhat more than 2/3 as long as that of segment 6, and it is possible that the holotype specimen represents a phenotypic sample slightly different from the material examined during this study. Horn (1888a, 1888b) recorded the type locality as "near Santa Cruz City, California," and *P. c. conjungens* is known to be widespread throughout the mountains surrounding the city of Santa Cruz. There is a tendency within the genus for species with high percentages of individual character variation within samples to coincidentally exhibit considerable interpopulational variation in the same characters. In any event, it is not possible to determine whether a single anomalous specimen actually represents a different locality sample or is merely an individual variant.

Females of *P. c. conjungens* are relatively small (Length: 27-32 mm), have the pronotal surface shining and only moderately densely punctate. Antennal segment 3 is short and subcylindrical or gradually expanded apically, segment 4 simple or feebly angulated anteriorly, segment 5 with a short lamella, segment 6 with a lamella distinctly shorter than that of segment 7, segment 9 distinctly longest.

Hazeltine (1950) records the probable host plants of *P. c. conjungens* as *Pinus ponderosa* Dougl., *Gnaphalium* sp., and *Quercus agrifolia* Nee, with larvae having been taken in an area of "grass and yellow pine roots."

Pleocoma conjungens lucia Linsley, **New Status**

Pleocoma lucia Linsley 1941:145-146.

Males of this subspecies, which is thus far known only from a small section of the Santa Lucia Mountains, differ from nominotypical specimens primarily by the reduced antennal formula, briefly characterized as follows: segment 3 subcylindrical, simple or very slightly angulated anteriorly, segment 4 simple or angulated anteriorly, segment 5 strongly transverse with acute process or short lamella, lamella of segment 6 from slightly more than 1/2 to about 4/5 as long as that of segment 7. Pronotal characters, such as the relative width of disc, shape of the posterior angles, and sculpturation of the lateral discal impressions intergrade evenly between the two subspecies and are therefore of little diagnostic value.

Females of *P. c. lucia* differ from specimens examined from Santa Cruz County by the much larger overall size (Length: 36.5-42 mm) and reduced antennal formula. Segment 3 is short and subcylindrical or subconical, segment 4 feebly angulated anteriorly, segment 5 transversely angulated anteriorly, segment 6 with acute process or short lamella, segment 7 with lamella about 3/4 as long as that of segment 8, segment 9 distinctly longest. Females of both subspecies have the pronotal disc very shiny and less coarsely, densely punctate than most other *Pleocoma* species.

I have collected larvae, pupae, and adults of this subspecies from cells in rocky clay soil, at depths ranging from about 36 cm to several meters below the soil surface. The larvae were found adjacent to small (6-10 mm diameter) rootlets of a young oak tree (trunk diameter approx. 20 cm) which appeared to be a slightly aberrant *Quercus agrifolia*. The sticky clay soil was thoroughly saturated from several days of heavy rainfall, and due to the constantly flowing mud, I was unable to observe actual larval feeding.

Type Localities: *P. conjungens,* "near Santa Cruz City, California"; *P. lucia,* (holotype) Frances Simes Hastings Natural History Reservation, near Jamesburg, Santa Lucia Mountains, Monterey County, California, (allotype) "collected near Jamesburg."

Material Examined: *P. c. conjungens*: 293 males, 15 females; CALIFORNIA: *Santa Cruz County*: Santa Cruz, Ben Lomond, Felton, Mt. Hermon, Scotts Valley, Redwood Glen, Waddell Creek; *P. c. lucia*: 74 males, 9 females; CALIFORNIA: *Monterey County*: Frances Simes Hastings Natural History Reservation, "G-16, near Jamesburg", Jamesburg, 7.3 mi N Tassajara Hot Springs on Greenfield Road, "Fish pond, Anastasia Canyon, 2 mi NW summit." (Fig. 1)

Types Examined: *P. conjugens, P. lucia.*

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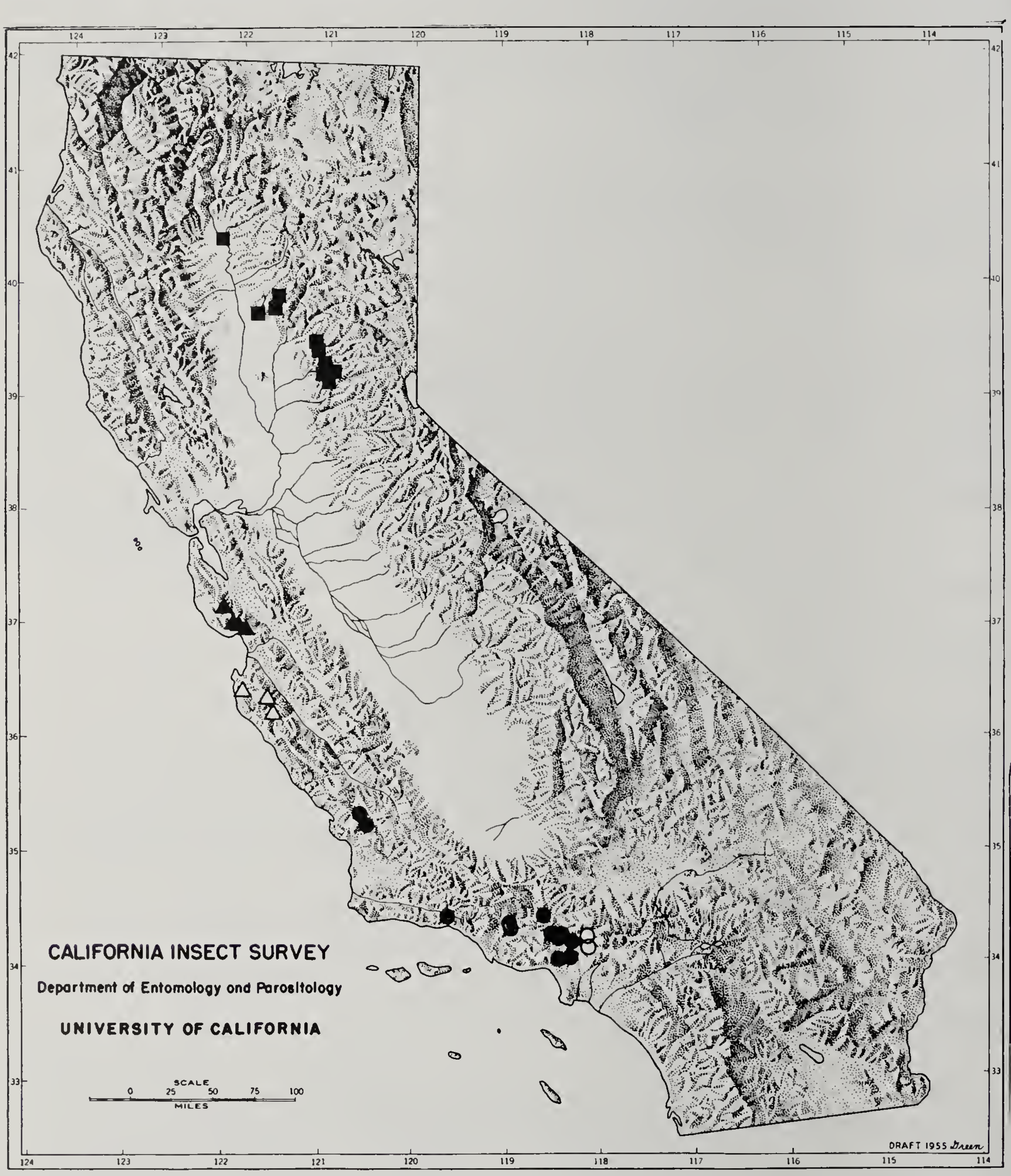

Fig. 1. Distributional map of *Pleocoma* species: *P. staff* (shaded squares); *P. c. conjungens* (shaded triangles); *P. c. lucia* (open triangles); *P. b. badia* (open circles); *P. b. hirsuta* (shaded circles).

CLASSIFICATION OF *LISTROPUS* PUTZEYS, A SUBGENUS OF *SCHIZOGENIUS* PUTZEYS (COLEOPTERA: CARABIDAE: SCARITINI)

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Abstract

The Neotropical taxon *Listropus* Putzeys, until now treated as a genus of the subtribe Scapterina, is reclassified as a subgenus of *Schizogenius* Putzeys in the subtribe Clivinina; therefore, the subtribe Scapterina is not represented in the New World. *Listropus* includes 7 known species arrayed in 3 species groups; these are keyed and discussed, locality records of the 6 South American species are mapped, and phylogeny and zoogeography are briefly discussed. One species not treated elsewhere as a *Schizogenius, S. brevicornis,* is redescribed and figured. **New combinations** in *Schizogenius* are *S. brevicornis* (Brullé), *S. iridescens* (Putzeys), and *S. xanthopus* (Brullé). **New synonymies** (junior names parenthetic) are *S. iridescens* (= *S. jacarensis* Whitehead and *Listropus micans* Putzeys) and *S. xanthopus* (= *S. grossus* Whitehead).

During our independent studies of Neotropical Scaritini, we have been puzzled by the taxon *Listropus* Putzeys. Putzeys (1863, 1866) treated *Listropus* as a genus related to *Scapterus* and *Thlibops*; thus it has been listed as the only New World representative of the scaritine subtribe Scapterina. The only subsequent discussion of *Listropus* was that of Jeannel (1946): "Sans doute le genre américain *Listropus,* que Putzeys rapproche de *Thlibops,* doit-il appartenir à une autre lignée." Recently, Whitehead identified as *Schizogenius jacarensis* Whitehead a rather strange scaritine that Reichardt had tentatively identified as *Listropus iridescens* Putzeys. This apparent synonymy, which prompted us to investigate the status of *Listropus,* proved to be correct.

In this paper the subgenus *Listropus* is recognized and defined, and member species are reclassified. This subgenus corresponds to the *jacarensis* and *optimus* groups of *Schizogenius s. str.* as defined by Whitehead (1972); Whitehead had been tempted to erect a subgenus for these groups but for reasons of conservatism did not do so.

Putzeys and later authors probably overlooked the relationship of *Listropus* to *Schizogenius* because they thought the median tooth of the mentum was absent. Two of the species included in *Listropus, L. brevicornis* (Brullé) and *L. xanthopus* (Brullé), are distinctive especially in their large size (*Listropus* originally included the huge, *Scarites*-like *L. brevicornis,* as *L. brevipennis* Putzeys), but their longitudinally carinate frons is characteristic of *Schizogenius*: In these 2 species and in the closely related *S. bicolor* Whitehead, the submentum and mentum are fused, and the mentum tooth is reflexed and readily observed only in frontal view. In the smaller forms included in *Listropus,* however, the suture between the submentum and mentum is distinct, and the mentum tooth is conspicuous.

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[1] Deceased.

J. Mateu and H. Perrin, Museum National d'Histoire Naturelle, Paris (MNHP) sent all specimens of *Listropus* they could find, including some but not all of the type-specimens of species described as *Listropus.* Also, in addition to specimens previously reported by Whitehead (1972), we examined a few specimens from the Institut Royal des Sciences Naturelles de Belgique (IRSB); the Museu de Zoologia, Universidade de São Paulo (MZSP); and the United States National Museum of Natural History (USNM). We thank Terry L. Erwin (Smithsonian Institution) and Gordon Gordh and Kellie O'Neill (Systematic Entomology Laboratory) for constructive criticism of the manuscript, and we thank Candy Feller for preparing figs. 2-7.

GENUS *Schizogenius* PUTZEYS

Schizogenius Putzeys 1846:650; Whitehead 1972:142-143.

See Whitehead (1972) for full systematic treatment. In that paper, the genus was subdivided into 2 subgenera, *Genioschizus* Whitehead and *Schizogenius s. str.* Since *Listropus* Putzeys is here recognized as a third subgenus to include some forms previously assigned to *Schizogenius s. str.*, we give a revised key to subgenera, rediagnoses of *Schizogenius s. str.* and *Listropus* Putzeys, a key to species of *Listropus,* redescription of *S. brevicornis* (Brullé), and new synonymic and distributional data on other included species. Standard measurements and abbreviations are as in Whitehead (1972).

KEY TO SUBGENERA OF *Schizogenius*

1. Lateral channel of elytron flared near apex, with 1 or more deep subapical pits .... *Genioschizus* Whitehead
1′. Lateral channel of elytron narrowed near apex, without deep subapical pits 2

2(1′). Hind tarsus elongate, Ta/Ti 0.75 or more; paramedian frontal sulci not microsculptured; clypeal suture weakly engraved; elytral disc asetose or with setae on interval 3 only.................. .... *Listropus* Putzeys
2′. Hind tarsi shorter, Ta/Ti under 0.75; paramedian frontal sulci microsculptured in most species; clypeal suture weakly to strongly engraved; elytral disc asetose or with setae on intervals 3, 3 + 5, or 3 + 5 + 7 .... *Schizogenius s. str.*

SUBGENUS *Schizogenius s. str.*

We here restrict this subgenus by transferring the *jacarensis* (= *iridescens*) and *optimus* groups to the subgenus *Listropus.* Since Whitehead's (1972) study was published, 2 new species have been discovered in Central America; these will be described by Terry L. Erwin in his Central American ground beetle study, in preparation. South American members of this subgenus need a complete revision, a study beyond the scope of this paper.

Diagnostic combination. Lateral channel of elytron not flared near apex, without deep subapical pits; hind tarsus short, Ta/Ti under 0.75; paramedian ambulatory setae of sternum 7 absent in females except those of *basalis* group and *S. pluripunctatus,* present in males. Also: paramedian clypeal carinae tuberculate or not, clypeal field narrow to broad, clypeal suture feeble to sharply impressed; paramedian frontal sulci microsculptured in most species; antennae moniliform to filiform; paralateral pronotal sulci absent; front tarsi dilated in many species, especially in males; elytra asetose or with setae on intervals 3, 3+5, or 3+5+7; pygidium serrate or crenulate in females of many species; and male endophallus of many species with well-developed basal collar spines. No species sellate, maculate, or strongly metallic. Size, LE 1.65-4.00 mm.

Distribution and natural history. See Whitehead (1972).

SUBGENUS *Listropus* PUTZEYS, **new status**

Listropus Putzeys 1863:3, 13. Type-species.—*Listropus brevipennis* Putzeys 1863, by monotypy. Putzeys 1866:10 (descriptions of new species); Jeannel 1946:220 (comments on systematic position).

Diagnostic combination. Lateral channel of elytron not flared near apex, without deep subapical pits; hind tarsus elongate, Ta/Ti 0.75 or greater; paramedian ambulatory setae of sternum 7 absent in female, present or absent in males. Also: paramedian clypeal carinae tuberculate or arcuate, clypeal field broad, clypeal suture generally feebly impressed; paramedian frontal sulci not microsculptured; antennae moniliform; paralateral pronotal sulci absent; front tarsi slender in both sexes; elytra asetose or with setae on interval 3 only; pygidium not crenulate in either sex; and male endophallus without well-developed basal collar spines. Some species either sellate or maculate, or brightly metallic. Size, LE 2.75-7.00 mm.

Distribution. The aggregate range of known members of this subgenus extends from extreme southern Mexico to northern Argentina. See fig. 7 for distribution records of South American species.

Natural history. We have extremely little knowledge of *Listropus* in nature. The scarcity of specimens in collections, Whitehead's (1972) notes on collecting *S. optimus* in Mexico, the large body size, and (notably in *S. brevicornis*) the modified mouthparts all are tantalizing hints that the natural histories of members of *Listropus* are dissimilar from those of *Genioschizus* and *Schizogenius s. str.*

Taxonomic notes. Of the 4 species recognized by Putzeys (1866) in the genus *Listropus,* only 3 are valid. All have been named more than once. Only *Listropus brevicornis,* the type-species of *Listropus* and at 12 to 13 mm total length the giant among species of *Schizogenius,* has not been redescribed in *Schizogenius* under a different name.

This subgenus includes those forms treated by Whitehead (1972) as the *jacarensis* and *optimus* groups of *Schizogenius s. str.*; here, the *jacarensis* group is renamed the *iridescens* group because of synonymy, and the *optimus* group is subdivided into the *optimus* and *brevicornis* groups because of a different interpretation of relationships.

With placement of *Listropus* as a subgenus of *Schizogenius,* subtribe Clivinina, the subtribe Scapterina is not represented in the New World.

KEY TO SPECIES OF SUBGENUS *Listropus*

1. Paramedian pronotal sulci well developed; interval 3 of elytron bi- or trisetose; suture between mentum and submentum distinct (*iridescens* group) .... *S. iridescens* (Putzeys)
1′. Combination of characters not as above 2

2(1′). Paramedian pronotal sulci obsolete or nearly so; suture between mentum and submentum distinct (*optimus* group) 3
2′. Paramedian pronotal sulci well developed; suture between mentum and submentum indistinct (*brevicornis* group) 5

3(2). Elytral interval 3 asetose; southern Chiapas in Mexico to southern Costa Rica .... *S. optimus* Bates
3′. Elytral interval 3 bi- or trisetose; Panama and South America 4

4(3′). Elytra piceous, metallic; clypeal carinae straight, apices abbreviated; elytra ovate .... *S. dyschirioides* Putzeys
4′. Elytra brunneous, unmetallic; clypeal carinae arcuate, apices joined and extended by stem to median tooth; elytra elongate, not ovate .... *S. clivinoides* Putzeys

5(2′). Elytron with large sutural macula .... *S. xanthopus* (Brullé)
5′. Elytron not maculate 6

6(5′). Black; LE over 6.0 mm; mentum and submentum concave .... *S. brevicornis* (Brullé)
6′. Brunneous or castaneous; LE under 4.0 mm; mentum and submentum normal .... *S. bicolor* Whitehead

THE *optimus* GROUP

Discussion. The *optimus* group as defined by Whitehead (1972) is probably not monophyletic, and it is sufficiently diverse to warrant subdivision into 2 species groups here, the *optimus* and *brevicornis* groups. The *optimus* group is here restricted to include species with the paramedian pronotal sulci obsolete, pronotal front angles not lobate, and the mentum and submentum not fused. Included are the only members of the old *optimus* group having such features as elytral interval 3 setose, metallic coloration, or clypeal carinae fused in an arc and joined to median tooth by a common stem. Type-specimens of *S. dyschirioides* and *S. clivinoides* have not yet been located. This group contains those members of the subgenus *Listropus* treated by Putzeys as *Schizogenius* rather than *Listropus,* probably because of the prominent median mentum tooth.

Schizogenius optimus Bates

Distribution. See Whitehead (1972).

Schizogenius dyschirioides Putzeys

Distribution. See Whitehead (1972) and fig. 7. The following are new records:

BOLIVIA. La Paz: 24 km. W Coripata (1; USNM). ECUADOR. Napo: Limoncocha (2; USNM). PERU. Huánuco: Tingo Maria (1; USNM).

Schizogenius clivinoides Putzeys

Distribution. See Whitehead (1972) and fig. 7.

THE *iridescens* GROUP

Discussion. This is the *jacarensis* group of Whitehead; the name is changed to reflect the following synonymy of the only included species.

Schizogenius iridescens (Putzeys), **new combination**

Listropus iridescens Putzeys 1866:11-12. Type-locality "Amazone", here restricted to BRAZIL: Pará: Santarém; holotype in MNHP.
Listropus micans Putzeys 1866:12. Type-locality "Brésil"; holotype in MNHP. **New synonymy.**
Schizogenius jacarensis Whitehead 1972:172-173, figs. 77, 81. Type-locality BRAZIL: Mato Grosso: Jacaré, Parque Nacional do Xingu; holotype in Museum G. Frey, Tutzing, Germany. **New synonymy.**

Discussion. The holotype of *L. iridescens* is light brown, somewhat teneral; that of *L. micans* is dark. In the original description of the latter, Putzeys wrote "Il ne serait pas impossible que cet insecte fût le [male sign] du précédent. . . ." The specimen differs slightly from the *L. iridescens* specimen, especially in the sculpture of the head (weaker longitudinal carinae in *L. micans*), but there is no doubt that the 2 specimens are conspecific; hence these names are synonymous. The holotype of *L. iridescens* bears the label ". . . Amaz. Bates". Because a specimen from Bates' collection (MNHP) is labelled "Santarem Amaz.", we here fix Santarém as the type-locality of *L. iridescens. S. jacarensis,* originally based on 2 specimens from Jacaré in Mato Grosso and 1 from Santa Isabel in Goiás, was named in the absence of information about *Listropus.*

Distribution. Fig. 7. In addition to type-specimens as cited above, there are the following records:

BRAZIL. Pará: Santarém (1; MNHP). Mato Grosso: Barra do Tapirapés (1; MZSP); Parque Nacional do Xingu (1; MZSP); Jacaré, Parque Nacional do Xingu (2; MZSP).

THE *brevicornis* GROUP

Discussion. Members of this group are distinguished from those of the *optimus* group by having the paramedian pronotal sulci normal, pronotal front angles lobate, and mentum and submentum fused. Included are the only members of the old *optimus* group (*sensu* Whitehead 1972) with LE over 4.0 mm, maculate elytra, 4 rather than 3 posteroventral setae near base of front tibia, mentum and submentum concave, labrum fringed laterally with more than 10 pairs of setae, mentum tooth blunt and reflexed, or antennal articles 3 and 4 plurisetose rather than pubescent.

Schizogenius bicolor Whitehead

Distribution. See Whitehead 1972 and fig. 7. The following is a new record:

BRAZIL. Mato Grosso: Jacaré, Parque Nacional do Xingu (3; MZSP, USNM).

Schizogenius xanthopus (Brullé), **new combination**

Clivina xanthopus Brullé 1837:39, pl. 4, fig. 10. Type-locality "dans la province de Moxos, au mois de Mai, sur les bancs de sable du Mamoré"; type-specimens not found in MNHP. Putzeys 1846:654.

Listropus xanthopus, Putzeys 1866:11.

Listropus discophorus Chaudoir 1863:118. Type-locality BOLIVIA: Santa Cruz: Valle Grande; holotype in MNHP. Putzeys 1866:11 (proposed synonymy with *L. xanthopus*).

Schizogenius grossus Whitehead 1966:3. Type-locality BRAZIL: Amazonas (?): "Rio Madeira"; holotype in USNM. Whitehead 1972:176-177 (new records). **New synonymy.**

Discussion. Even though the holotype of *C. xanthopus* was not found in MNHP (its presumed depository), its description exactly fits *L. discophorus* and *S. grossus.* The type-locality of *C. xanthopus* is presumably the Rio Mamoré, Llanos de Mojos, Bení, Bolivia.

Distribution. See Whitehead (1966, 1972) and fig. 7. The following is a new record:

BRAZIL. Amazonas: Tefé (formerly Ega) (1; MNHP).

Schizogenius brevicornis (Brullé), **new combination**

Scarites brevicornis Brullé 1837:39, pl. 3, fig. 9. Type-locality "province de Santa-Cruz de la Sierra, sur les dunes de sable mouvant de la maison de Mercado, chemin de Santa-Cruz à Chuquisaca"; type-specimens not found in MNHP.

Listropus brevicornis, Putzeys 1866:10 (transferred to this genus).

Listropus brevipennis Putzeys 1863:13-16, figs. 10-12. Type-locality "deux exemplaires comme venant de la Plata. J'en ai vu un troisième, mais mutilé, dans la collection de M. Chevrolat"; type-specimens not found in MNHP or IRSB. Putzeys 1866:10 (proposed synonymy with *S. brevicornis*).

Diagnostic combination. This species is easily recognized by the large size, with LE over 6.0 mm; by the large tooth on the left mandible; and by the combination of black or piceous coloration and fused, concave mentum and submentum.

Description. Fig. 1. Similar to *S. xanthopus* (=*S. grossus* in Whitehead 1966) except as follows. Color piceous to black, antennae, palpi, and tarsi rufous. Fine isodiametric microsculpture on gena, gula, tibiae, anterior surfaces of front and middle femora and posterior surfaces of hind femur, basal 3rd of elytral epipleuron, and entire abdomen. Visible sterna 1 and 2 rugose laterally.

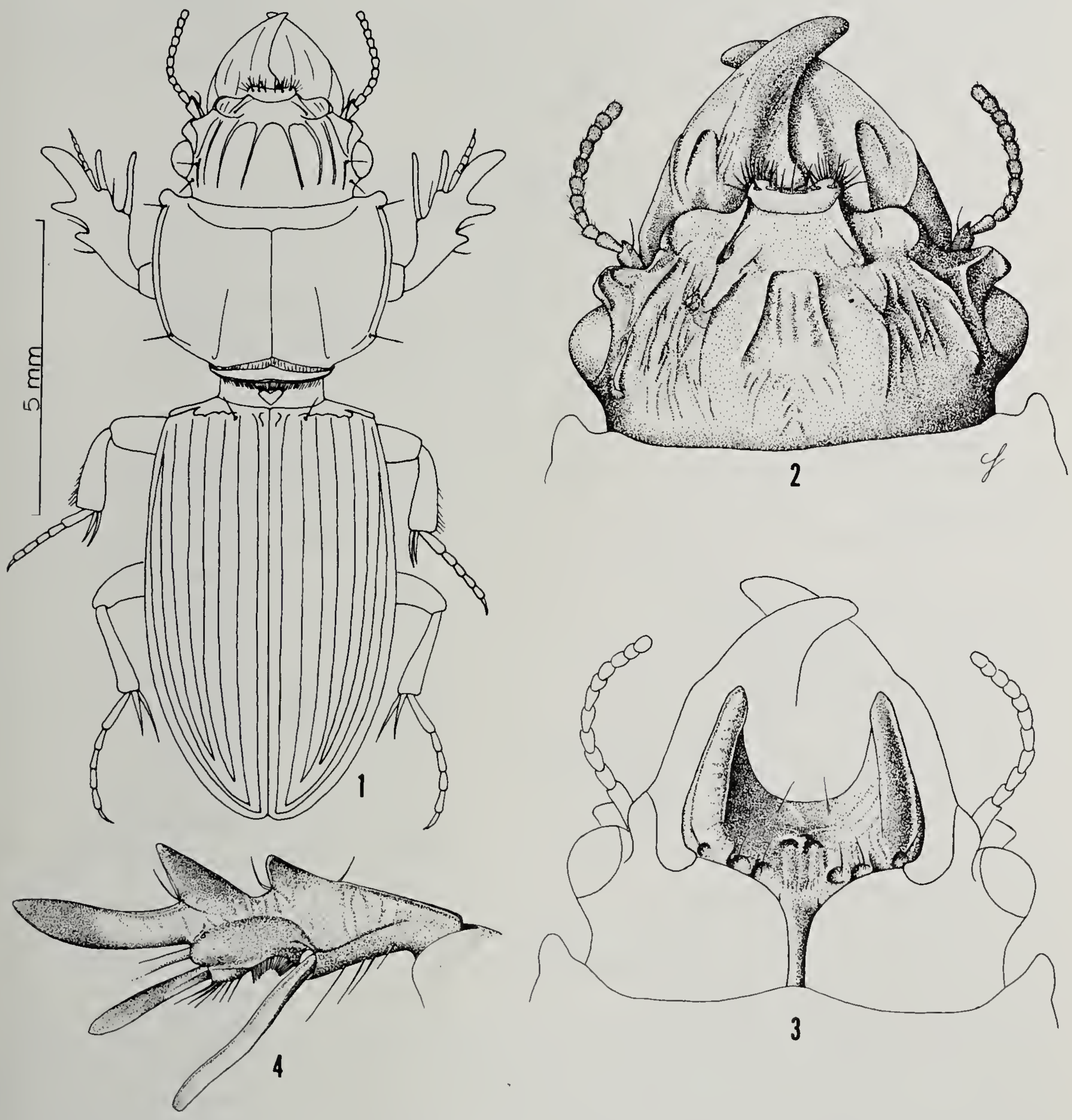
Head. Fig. 2. Labrum deeply emarginate. Clypeus with median tooth obsolete, paramedian carinae feebly. Clypeal suture deep (1 specimen) or obsolete (1 specimen). Frons with longitudinal carinae feeble, little more developed than longitudinal rugae and confused with them. Eyes proportionately smaller. Mentum and submentum (fig. 3) fused, concave; arcuate carina inconspicuous; median tooth of mentum short and broad, reflexed, visible only in anterior aspect; mandibles longitudinally rugose, left mandible with large tooth behind middle (fig. 2).

Pronotum more transverse, paramedian sulci shorter (PS/LP 0.50-0.55), anterior transverse impression smooth. Legs (fig. 4), elytra, and abdomen as in *S. xanthopus* except for color and microsculpture. Genitalia not examined.

Measurements and proportions, based on 2 specimens. TL, 10.27-10.80 mm; LE, 6.27-6.58 mm; WH, 3.11-3.42 mm; WP, 3.79-4.09 mm; WE, 3.91-4.22 mm; WF/WH, 0.79-0.80; LP/WP, 0.65-0.68; WP/WE, 0.63-0.66; Ta/Ti, 1.11-1.15.

Discussion. Unequivocal type-specimens of the 2 named forms were not found in IRSB or MNHP, but the 3 specimens that we examined agree with both descriptions. One specimen in IRSB bears the label, in Putzeys' hand, "Listropus brevicornis Boliv. (C. Chd.)"; though not here regarded as type-material, this specimen may have come to Putzeys from Brullé through Chaudoir.

Distribution. In the original description of *L. brevipennis,* Putzeys (1863) cited the type-specimens as from La Plata, Argentina. Later (1866:11) he wrote "cet insecte vient de la Bolivie et non de la Plata." We cannot determine what the range is, but assume that only the Bolivian records are correct (fig. 7). We examined the following specimens:



Figs. 1-4, *Schizogenius brevicornis*: 1, habitus; 2, dorsal view of head; 3, ventral view of head, detail of mentum and submentum; 4, posterior view of front tibia.

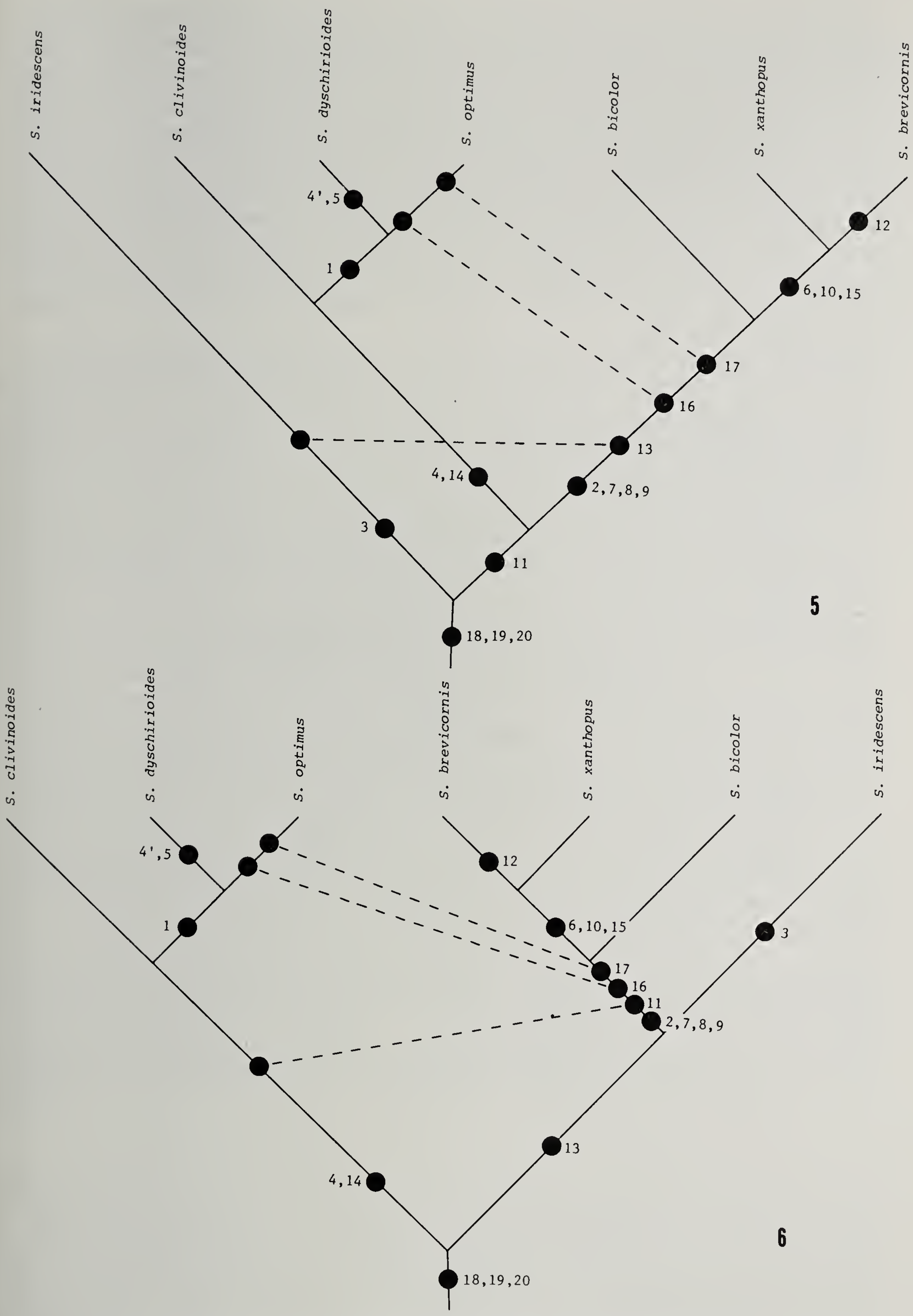
No locality (1; MNHP). BOLIVIA. Yuracary (?) (1; MNHP; this specimen might be from the Yuracares area of southwestern Bení or northwestern Santa Cruz, or from near Yura or Rio Yura, Potosí province); no locality (1; IRSB).

EVOLUTIONARY CONSIDERATIONS

The poor representation of species in collections, lack of adequate records of known species, and lack of knowledge of type-specimens of *S. dyschirioides* and *S. clivinoides* combine to make presumptuous a detailed discussion at this time. However, we think it desirable to summarize what we know about the phylogeny and zoogeography of this subgenus. The diversity of the group is unknown. However, the divergence is obviously great and thus so must be the antiquity of the group. Only *S. optimus* and *S. dyschirioides* are obviously closely related and can be considered as true, vicarious sister species. Relationships of all other known taxa are more distant. We predict that, particularly among the *brevicornis* group, additional species will be found in South America.

TABLE 1. Character states used for phyletic analysis of *Listropus*.

	Character	Character state	
		Plesiotypic	Apotypic
1.	Color strongly metallic	no	yes
2.	Antennal articles 3 & 4	pubescent	plurisetose
3.	WH/WP	under 0.85	over 0.85
4.	Clypeal carinae	tuberculate	arcuate (4), tuberculate (4′)
5.	Antennal pedicel	unisetose	bisetose
6.	Pairs of marginal labral setae	6-7	10-15
7.	Tooth of mentum	prominent	reflexed
8.	Mentum/submentum suture	distinct	obsolete
9.	Base of arcuate carina of mentum	raised	obsolete
10.	Width gula/width mentum	over 0.1	under 0.1
11.	Arrangement of palpal "bristles"	transverse	longitudinal
12.	Tooth of left mandible	absent/weak	strong
13.	Pronotal front angles	non-lobate	lobate
14.	Paramedian pronotal sulci	normal	obsolete
15.	Posteroventral setae of front tibia	3	4
16.	Setae of elytral interval 3	present	absent
17.	Paramedian setae of last male ventrite	present	absent
18.	Setae of elytral intervals 5 & 7	present	absent
19.	Microsculpture of frontal sulci	present	absent
20.	Ta/Ti	under 0.75	over 0.75



Figs. 5-6, Equally parsimonious reconstructed phylogenies of *Schizogenius (Listropus),* dashed lines indicating character convergences: 5, poorly defended hypothesis based on arrangement of palpal bristles; 6, well-defended hypothesis based on form of pronotal front angles. See table 1 and text for details.

Phylogeny. Relationships of the subgenus to other subgenera of *Schizogenius* were indicated by Whitehead (1972:323, fig. 255). Our views on relationships within the subgenus are summarized by the standard phylogenetic trees in figs. 5-6, supported by data in Table 1. These hypotheses are equally parsimonious in terms of required convergences. The hypothesis in fig. 5 is not convincing because of weakness in its basal dichotomy (character 11), arrangement of the so-called "bristles" of the terminal palpal articles. The character state for this was not checked in *S. brevicornis,* and is not known for *S. clivinoides.* Moreover, the character needs to be re-evaluated by scanning electron microscopy. In contrast, the lobate form of pronotal front angles (character 13) is a convincing apotypic state; thus the hypothesis in fig. 6 is favored.

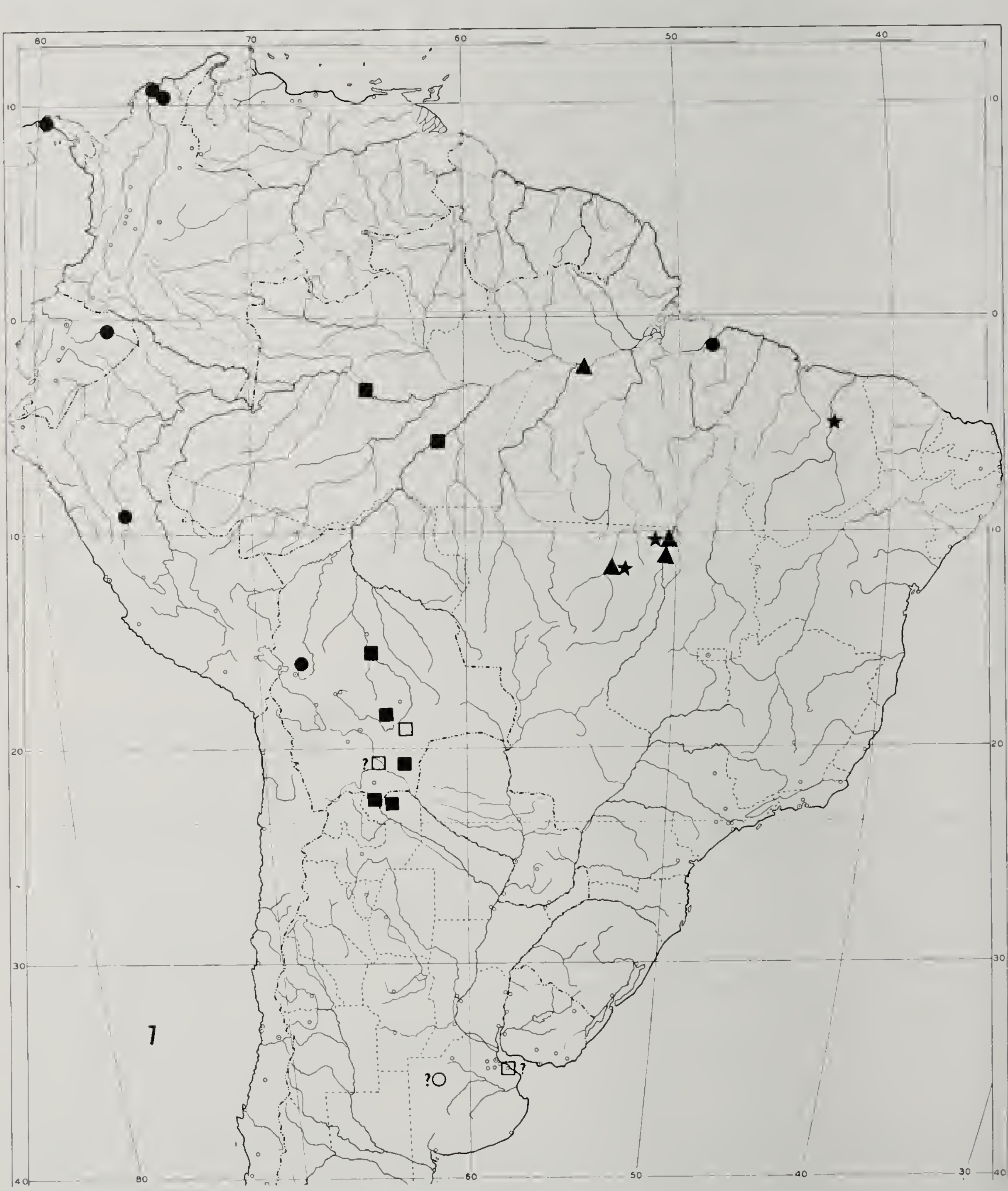


Fig. 7, Distribution records of South American members of *Schizogenius (Listropus)* (? = imprecise locality): Closed circle, *S. dyschirioides*; open circle, *S. clivinoides*; triangle, *S. iridescens*; star, *S. bicolor*; closed square, *S. xanthopus*; open square, *S. brevicornis.*

Within the *optimus* group, we can interpret characteristics of *S. clivinoides* only from the original description. Relationships suggested by figs. 5-6 are based on the apparent sister species status of *S. optimus* and *S. dyschirioides* and on geographic considerations. Thus, probable ancestral features of the group include: Elytral interval 3 setose; integumental color non-metallic; antennal pedicel unisetose; and clypeal carinae arcuate and extended to apex of clypeus by a common stem. The tuberculate form of the clypeal carinae in *S. dyschirioides* is interpreted as a secondary reduction.

Zoogeography. Distribution records of the 6 South American members of the subgenus *Listropus* are summarized in fig. 7. Origins and centers of distribution are clearly in South America, but where? It may be no accident that known records of most of the species are peripheral to watercourses of the lower Amazon and northeastern Brazil. Probably, these peripheral areas with their varied topography are where the greatest diversification has taken place, the region occupied by *S. iridescens* and *S. bicolor* being a haven for relict species. The only known occurrences of sympatry are those of the latter 2 species, at Jacaré and Barra do Tapirapes. However, 3 species are known from Bolivia—a poorly collected area—and of these the sister species *S. brevicornis* and *S. xanthopus* must be sympatric since each is represented in both upper Amazon and upper Plata drainages.

With these points in mind, we suggest the following scheme of evolutionary history based on the phylogeny suggested in fig. 6. We make no attempt to consider timing of events. The ancestor of the subgenus became widespread in the Amazon basin; then its range subdivided into eastern (*iridescens* & *brevicornis* groups) and western (*optimus* group) lineages. The latter expanded into the Plata system and then diverged into Amazon (ancestral *optimus-dyschirioides*) and Plata (*S. clivinoides*) segregates. Ancestral *iridescens-brevicornis* expanded westward, subsequently diverging into western (*brevicornis* group) and eastern (*iridescens* group) ancestors. Ancestral *brevicornis* then expanded its range eastward into lower Amazon drainages, with subsequent divergence of *S. bicolor*. The western segregate of ancestral *brevicornis* expanded over upper drainages of both Amazon and Plata and diverged into *S. brevicornis* and *S. xanthopus*. These in turn each redispersed over the same area originally occupied by their common ancestor.

Discussion. Additional taxonomic data, perhaps from immature stages or from natural history, are needed to test the hypotheses of relationship and to determine which is the most plausible before any more meaningful zoogeographic relationships can be suggested. Does the suggested vicariance between upper and lower parts of the Amazon have any factual, historical basis? How do natural histories of these beetles affect their distributions? Can distributions be correlated, on a general or detailed level, with postulated Pleistocene refugial events (Haffer 1969; Vanzolini and Williams 1970; Whitehead 1976)? We hope that the introductory taxonomy done in this paper will stimulate the needed exploration.

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NEW SPECIES AND TAXONOMIC CHANGES IN THE GENUS *ENOCHRUS* (COLEOPTERA: HYDROPHILIDAE)

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Abstract

This article presents 6 new Nearctic species of the genus *Enochrus* (*E. pseudochraceus, E. interruptus, E. aridus, E. sharpi, E. sayi,* and *E. negrus*) and 7 subspecies (*E. carinatus carinatus, E. c. fucatus, E. piceus piceus, E. p. glabrus, E. pygmaeus pygmaeus, E. p. nebulosus,* and *E. p. pectoralis*). The controversial *E. pygmaeus* and *E. hamiltoni* groups are discussed. *Enochrus hamiltoni, E. horni, E. conjunctus,* and *E. collinus* are combined as a highly polymorphic species (*E. hamiltoni*) which can only be divided into color-forms and not subspecies. Lectotypes and paralectotypes are designated for many of the *Enochrus* described by LeConte, Horn, Fall, Melsheimer, and Zimmerman.

This article is intended to present new species, subspecies, and synonomies so they will be available for a later publication on the whole genus.

The revision of the genus *Enochrus* of which this is a part was done at the University of Minnesota under Dr. Edwin Cook, Department of Entomology, Fisheries and Wildlife. Thanks to Dr. Cook's long enduring encouragement, this study has reached completion. Material for this revision was borrowed from some 40 institutions in the United States and Canada, but special thanks must go to Hugh Leech, Paul Spangler, Margaret Thayer, and David Miller for their comments and loans of large numbers of specimens. Numerous student assistants should also be acknowledged for their many hours of work in mapping, tallying, labeling, assembling plates, and innumerable other things over the years.

The genus *Enochrus* is represented by 24 species and 7 subspecies in the Nearctic Region. Although this genus is abundant and widespread, it has long been neglected. Revision of the genus revealed 6 new species, and study of material from the whole Nearctic has forced several taxonomic shifts within the genus.

Because of the large number of specimens examined distribution lists have not been included, although complete lists of specimens examined up to 1965 for the subgenera *Enochrus* and *Methydrus* are available in my thesis (Gundersen, 1967, pp. 211-253). Distributions are summarized at the end of each species description and represented in maps (fig. 73-85). A complete monographic treatment of the genus will be available as a separate publication from the author later in 1977.

Enochrus (Enochrus) carinatus carinatus (LeConte)
Figs. 1-3, 60, 76

Philhydrus (Philhydrus) carinatus LeConte 1855:370; (*nec* Horn 1873:126, 127) Miller 1964:69-70.
Enochrus (Enochrus) carinatus (LeConte); Miller 1964:69-70 (*partim*).

LECTOTYPE: female; gold dot and San Francisco, (San Francisco and San Jose in description); Type No. 3085, LeConte Collection, MCZ. PARALECTOTYPE: female; same data (missing head and prothorax); Type No. 3085^2, LeConte Collection, MCZ.

LENGTH: 4.2-5.2 mm. WIDTH: 2.5-3.0 mm. COLOR: Dorsally yellow to yellowish-brown, head solid black (corners of head may appear lighter because of thinness), epipleura distinctly pale. ANATOMY: Last segment of maxillary palpi equal to or longer than penultimate; prosternal crest low but distinct, raised sharply anteriorly (fig. 2); mesosternal crest large, triangular, distinct tooth at tip, series of long setae on posterior edge (fig. 3); clypeal emargination fairly shallow, smoothly rounded; abdominal notch medium width and depth, W/D = 3.4 (fig. 60); male prosternal claws basally enlarged, sharply bent; male genitalia typical, medium lobe 0.7 and dorsal strut 0.85 length of slender-tipped parameres (fig. 60).

DISCUSSION: The color pattern and proportions of the maxillary palpus separate this beetle from all other *Enochrus*. The original confusion was evidently due to a mistranslation by Horn of the original Latin description. He assigned the older name, *carinatus,* to what was the new black species (*E. piceus*), and the new name, *fucatus,* to the true yellow *E. carinatus*. Winters (1927) and others followed Horn's work without checking the types. Miller (1964) corrected the mistake.

DISTRIBUTION: Throughout California (fig. 76).

SPECIMENS EXAMINED: 313.

An interesting parallel variation occurs in *E. carinatus* and *E. piceus*. In the southern part of their ranges (Arizona, New Mexico, and Mexico) several long hairs typically present on the mesosternal crest are lacking. The southern forms also vary slightly in other anatomical features and color. To acknowledge this variation, I am separating these populations as subspecies of their respective species.

Enochrus (Enochrus) carinatus fucatus (Horn), **new status**
Figs. 4, 5, 76

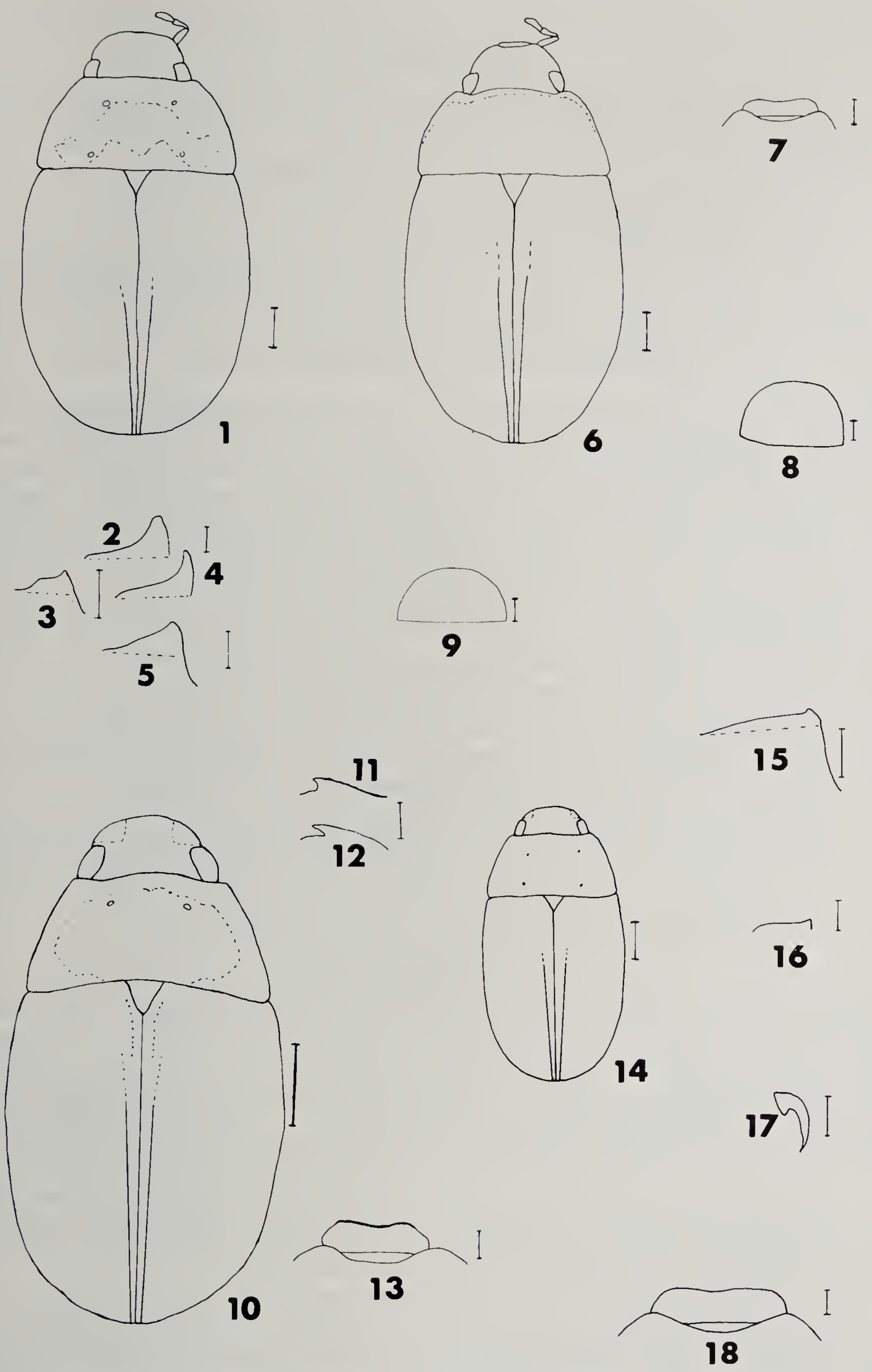
Philhydrus (Philhydrus) fucatus Horn 1873:127
Philydrus (Enochrus) fucatus; Horn 1890:244.
Philhydrus discedens Sharp 1882:67 (cotype examined July, 1966 USNM), **new synonymy.**

LECTOTYPE: male; Utah; Type No. 2975, Horn Collection, MCZ (formerly ANS Phila.). PARALECTOTYPE: sex unknown; Utah; Type No. 3096, LeConte Collection, MCZ.

LENGTH: 4.3-5.5 mm. WIDTH: 2.5-3.2 mm. The description of the typical *E. carinatus* fits *E. carinatus fucatus* with the following exceptions: very few to no setae on mesosternal crest; prosternal and mesosternal crests higher (figs. 4, 5); color somewhat paler; and size averaging slightly larger.

DISTRIBUTION: Arizona, New Mexico, western Texas, and Central Mexico (fig. 76).

SPECIMENS EXAMINED: 63.



Figs. 1-18: 1-3, *Enochrus carinatus carinatus* (1, habitus; 2, prosternal crest; 3, mesosternal crest); 4-5, *E. c. fucatus* (4, prosternal crest; 5, mesosternal crest); 6-8, *E. piceus piceus* (6, habitus; 7, clypeal emargination; 8, section across abdomen); 9, *E. mexicanus,* section across abdomen); 10-13, *E. pseudochraceus* (10, habitus; 11-12, mesosternal crest; 13, clypeal emargination); 14-18, *E. sharpi* (14, habitus; 15, mesosternal crest; 16, prosternal crest; 17, male protarsal claw; 18, clypeal emargination); (scale line represents 0.5 mm, figs. 1, 6, 8-10, 14; 0.2 mm, figs. 2-5, 7, 13, 15, 16, 18; 0.1 mm, figs. 11, 12, 17).

Enochrus (Enochrus) piceus piceus Miller
Figs. 6-8, 59, 77

Philhydrus carinatus; Horn 1873:126-127 (*partim*); (*nec* LeConte) Miller 1964:70-71.

Philydrus (Enochrus) carinatus; Horn 1890:242-244 (*partim*); (not *Philhydrus* as listed in Miller 1964:70).

E. (E.) piceus Miller 1964:70-71 (*partim*).

HOLOTYPE: male; Wilbur, Wash., VIII-24-1932; U. Wash. (not examined). ALLOTYPE: female; same data as holotype. U. Wash. (not examined). PARATYPES: 100; Washington, Idaho, Oregon, California (see Miller 1964 for exact list and deposition) (20 paratypes examined, 6 retained: Wilbur, Washington (2, UW); Pistol River, Oregon (2, UW, CMNH); Lake Lowell, Washington (1, UW); Roseburg, Oregon (1, UW)).

LENGTH: 4.3-6.0 mm. WIDTH: 2.2-2.8 mm. COLOR: Dorsally black, corners of clypeus slightly lighter (fig. 6). ANATOMY: Punctation of elytra coarser than that of pronotum and head; prosternal crest low, raised only anteriorly; mesosternal crest a broad triangle, possible tooth at tip, series of long hairs on posterior margin; clypeal emargination smoothly rounded (fig. 7); abdominal notch medium depth and width, W/D = 2.7 (fig. 59); male protarsal claws with small pointed basal lobe, moderately curved; male genitalia typical (fig. 59), median lobe 0.75 and dorsal strut 0.82 length of parameres; slightly longer and thinner than those of *E. carinatus*.

DISCUSSION: Within its range *E. piceus* resembles *E. mexicanus* and the dark phase of *E. hamiltoni*. Presence of an abdominal notch and prosternal crest separate it from *E. hamiltoni*. Its greater convexity (figs. 8, 9) and almost complete lack of yellow margins separate it from *E. mexicanus*. It bears a resemblance to the *E. cinctus-perplexus* group also, but these species are mainly eastern, have no prosternal crest, and have the last maxillary palp segment shorter than the penultimate.

E. carinatus and *E. piceus* are anatomically very close, distinguished almost exclusively on the basis of color pattern. Miller (1964) had difficulty in distinguishing between some *E. piceus* and *E. carinatus* in Oregon, and indicated a suspicion that they might be color forms of a single species. Perkins (1972), studying larvae of Hydrophilidae in Los Angeles County, California, found no dependable differences in the immatures. The parallel subspecies and widely overlapping distributions also lead to suspicion that they are merely color variations. I have, however, found virtually no color intermediates. *E. piceus* is always dark over the whole upper surface except for the corners of the clypeus. If the elytra are brown, then the head is also. *E. carinatus,* on the other hand, always has the head solid black, and even in light (teneral) specimens the head is much darker than the elytra. This does not preclude the possibility of synonomy. The final decision will have to be based on rearing and observation in the field.

This species has been recorded in 2 very interesting and contrasting habitats: hot springs at pH 8.3-9.3, salinity 1.0025-1.0074, and temperature 29-37.6°C (Brues 1932, *E. piceus piceus*); and under rocks in a stream which was partially covered with ice (La Rivers 1954, *E. piceus glabrus*).

DISTRIBUTION: Pacific Northwest from California to southern British Columbia west to Utah and Wyoming (fig. 77).

SPECIMENS EXAMINED: 1070.

Enochrus (Enochrus) piceus glabrus Gundersen, **new subspecies**

HOLOTYPE: male; Sunnyside Cn. W. side Huachuca Mts., 6,000 ft., Cochise Co., Arizona VIII-4-1952, H. B. Leech collector; Type No. 9376, CAS. ALLOTYPE: female;

same data as holotype, CAS. Paratypes: 1, same data as holotype; 1, Chiricahua Mts., 5,000 ft., 3.5 mi. SW Portal, Arizona, Cochise Co., VIII-13-1952, H. B. Leech collector; 1, Miller Cn., Huachuca Mts., VII-23-1955, F. X. Williams, CAS.

Length: 5.0-5.7 mm. Width: 2.7-3.0 mm. The description of the typical *E. piceus* fits *E. p. glabrus* with the following exceptions: dorsal surface and legs slightly darker, corners of pronotum somewhat paler; mesosternal crest a little sharper with few to no long setae on posterior edge; punctation fine over whole dorsal surface.

Discussion: See discussion under *carinatus carinatus* and *piceus piceus*.

Distribution: Arizona to extreme western Texas (fig. 77).

Specimens examined: 32.

Enochrus (Methydrus) cinctus (Say)

The cotypes of this species were lost probably before reaching a museum, but the description was clear and reference was made to its presence in Pennsylvania. Say (1924) listed the type locality as "Red River of Lake Winnepeck" (Red River leading to Lake Winnepeg, Ontario on the Minnesota-North Dakota Border; Map in Barber (1928) and description of route in Say's letter to J. Melsheimer in 1823 (Fox 1902).

LeConte, in a note in his reprinting of the "Complete Works of Thomas Say (1859), stated that this was a "*Philhydrus*". LeConte (1855) and everyone since then has used this name unhesitatingly to refer to what is now known as *E. cinctus*. Therefore, I see no reason not to designate a neotype from material bearing that name. Because the original locality is on the fringe of the species range and no specimens were available from the type locality, a specimen from near the center of the range has been selected.

Cotypes: Red River of Lake Winnepeek, August, 1823, *LOST*.

Neotype: male; Ringwood, Ithaca, N.Y., VII-14-1917, Dietrich collector; (Determination label: "*E. cinctus*, det. Dietrich"); Type No. 4422, Cornell.

Enochrus (Methydrus) interruptus Gundersen, **new species**

Figs. 52-57, 69, 79

Holotype: male; Okeechobee, Florida, III-18-1943, Wm. Procter collector; Chamberlain Collection; (bore labels "*E. cinctus* Say, det, Deitrich and *E. perplexus* Lec."); Type No. 4423, Cornell. Allotype: female; same data as holotype, Cornell. Paratypes: Cornell: 1, same data as holotype; 1, same data but III-19-1943; 3, Lake Placid, Florida, IV-2-1945, J. G. Needham (1 in author's collection); 2, Lake Placid, III-IV-1945 (1 in author's collection); 5, Lake Placid, IV-19-1950; CNM; 5, 3 mi. SW. Lake Marion, Florida, III-15-1956 (1 in author's collection); 6, same data but III-14-1956, lights (1 in author's collection).

Length: 4.8-6.0 mm. Width: 2.6-3.5 mm. Color: Dorsally black corners of clypeus, edges of pronotum and elytra narrowly to broadly brown to yellow (fig. 52), palpi completely yellow. Anatomy: Prosternum not carinate; mesosternal crest a large, thin triangle (fig. 54); clypeal emargination smoothly rounded (fig. 53); abdominal notch wide but shallow, W/D=4.3 (fig. 69); protarsal claws of male only slightly enlarged basally (figs. 55, 56); male genitalia with tips of parameres bent outward at tip (fig. 69), a small notch 0.4 from base of paramere on inner edge, median lobe 0.4 and dorsal strut 0.85 length of parameres; dorsal strut in lateral view abruptly thickened and curved upward near tip.

Discussion: Specimens of this species were formally placed under one of these names: *E. consors, E. consortus, E. perplexus,* or possibly *E. cinctus*. *E. interruptus* is most similar to a rather robust *E. perplexus,* about intermediate in convexity between this species and *E. consors* and *E. consortus*. *E. interruptus* is distinguished from *E. consors* and *E. consortus* by its thinner mesosternal crest, thinner parameres, longer median lobe, and less convex body. *E. interruptus* is distinguished from *E. perplexus* by the deeper abdominal notch, more sharply bent dorsal strut, notched paramere, and more convex body (fig. 57, 58).

DISTRIBUTION: Louisiana, Florida, and Georgia, also New Jersey (fig. 79).

SPECIMENS EXAMINED: 116.

Enochrus (Methydrus) pseudochraceus Gundersen, **new species**

Figs. 10-13, 62, 80

Philhydrus ochraceus; Sharp 1882:70 (*partim*)

HOLOTYPE: male; 12 miles southwest of Liberia, Costa Rica, VII-13-1965; collected by P. J. Spangler, Type No. 69621, USNM. ALLOTYPE: female, same data as holotype, USNM. PARATYPES: 320 males and 255 females; same data as holotype, USNM and author's collection (5 males, 5 females).

LENGTH: 2.7-3.7 mm. WIDTH: 1.5-2.0 mm. COLOR: Dorsally yellowish-brown to brown; center of pronotum slightly to distinctly darker; vertex and central 0.6 of clypeus black (fig. 10). ANATOMY: Prosternum not carinate; mesosternal crest low and rounded (figs. 11, 12), a distinct backward pointing tooth just posterior of the middle; clypeal emargination slightly flattened centrally (fig. 13); abdominal notch deep (fig. 62), W/D = 1.3; male genitalia with tips flattened and out-turned (fig. 62); median lobe very long, broad, pointed, 0.95 length of parameres; dorsal strut not visible ventrally, equal in length to median lobe.

DISCUSSION: This species is Neotropical, but occurs along most of the southern border of the Neartic. *E. pseudochraceus* is very similar to *E. ochraceus* in general appearance and structure. However, the backward pointing tooth on the mesosternal crest of *E. pseudochraceus* and the respective differences in genitalia easily separate them (figs. 61, 62). The lack of a prosternal crest separates it from the very similar *E. pygmaeus* complex found in parts of the same area. The series labeled *Philhydrus ochraceus* by Sharp in 1882 contained both *E. ochraceus* and *E. pseudochraceus.*

Balfour-Browne first recognized this species and in his collection tentatively gave it the name "*E. d'orchymonti*". This name had already been used by Mouchamp (1956). Dr. P. J. Spangler compared specimens of *E. pseudochraceus* to the specimens in Balfour-Browne's collection in 1966 and found them to be conspecific. This left the species with no valid or published name.

DISTRIBUTION: East and west coasts of Mexico, Central America, throughout the West Indies, and possibly down the west coast of South America (fig. 80).

SPECIMENS EXAMINED: 2,000.

Enochrus pygmaeus complex

This very abundant, widespread group consists of 7 species and 3 subspecies in the Nearctic. Of these, 5 species and 3 subspecies are found in the United States. They are medium to small, 2.7-4.8 mm., and have both prosternal and mesosternal crests. Attempts to classify this group have produced serious taxonomic disagreements. Some have combined while others have split the group into many species. Horn (1890) and Zaitzev (1908) have included the whole complex, except *E. cristatus,* under the name *E. nebulosus,* while listing *E. pygmaeus* as a questionable species. Leech (1948) considered them as a complex and gave a very complete discussion of the geographic forms and suggested likely synonomies. His breakdown of species and subspecies agrees quite closely with mine. For a more complete list of synonomies than possible here, see Gundersen (1967).

Enochrus (Methydrus) pygmaeus (Fabricius)

Hydrophilus pygmaeus Fabricius 1792:186, no. 23; 1801:254, no. 28.

Enochrus pygmaeus can be separated into 3 subspecies. Specimens from the centers of their respective ranges can easily be separated: (1) typical ssp.—West Indies and Mexico-United States border, (2) ssp. *E. p. nebulosus* —east-central states, and (3) ssp. *E. p. pectoralis*—western states. However, where the 3 subspecies meet in southern Texas and Mexico, they are virtually indistinguishable. To determine which subspecies is referred to in local keys and faunal lists, check the distribution maps (Fig. 81, 82, 84).

Enochrus (Methydrus) pygmaeus pygmaeus (Fabricius)

Figs. 29-33, 63, 81

Hydrophilus pygmaeus Fabricius 1792:186, no. 23 (Americae meridionalis aquis, Dr. Pflug); 1801:254, no. 28 (Americae meridionalis insulis, Dr. Pflug).

Enochrus pygmaeus pygmaeus (Fabricius); Young 1953:14.

E. (Methydrus) pygmaeus complex, No. 1; Leech 1948:452 (*partim*).

E. (M.) rossi Leech 1948:451 (Type No. 5467, CAS, paratype examined).

HOLOTYPE: (only specimen in Fabricius collection) "Americae meridionalis Insulis, Dr. Pflug." (Antilles). Kiel Museum (on loan to Copenhagen Museum in 1966); (see d'Orchymont 1933, p. 307, for type locality discussion.) (Specimens sent to Copenhagen Museum for comparison.)

LENGTH: 3.4-4.8 mm. WIDTH: 1.85-2.7 mm. COLOR: Dorsally yellowish-brown to brown except head and center of clypeus (fig. 29); ventrally black, prosternum and mesosternal crest may be lighter. ANATOMY: Punctuation fine to medium over whole dorsal surface; prosternal crest high and sharp (fig. 33) mesosternal crest large (fig. 32), tip drawn out to a distinct tooth, posterior edge straight to slightly convex, clypeal emargination smoothly rounded to slightly flattened; abdominal notch medium width, fairly deep (fig. 63), W/D = 2.1; male protarsal claws slightly toothed but sharply bent (figs. 30, 31), male genitalia (fig. 63) with median lobe 0.65, dorsal strut 0.8 length of slender-tipped parameres.

DISCUSSION: *Enochrus pygmaeus pygmaeus* is most similar to *E. sayi* and the other *pygmaeus* subspecies. It differs from *E. p. pectoralis* in having heavier punctation, larger size, and longer mesosternal crest (figs. 32, 34, 35). Although similar in punctation to *E. p. nebulosus, E. p. pygmaeus* is larger and has a larger mesosternal crest. *E. sayi* has the same basic color pattern, but the posterior margin of its mesosternal crest is broadly convex (fig. 27) and its prosternal crest is low (fig. 26).

DISTRIBUTION: Florida, southern portions of the southern states from Florida to California, Lower California, east and west coasts of Mexico, the northern West Indies to the northern Antilles (fig. 81).

SPECIMENS EXAMINED: 287.

Enochrus (Methydrus) pygmaeus nebulosus (Say)

Figs. 38, 39, 64, 84

Hydrophilus labiatus Knoch; Melsheimer 1806:47, no. 1049 (*nomen nudum*)

H. nebulosus Melsheimer 1806:47, no. 1049 (*nomen nudum*)

H. nebulosus Say 1924:277.

Enochrus pygmaeus complex, no. 1; Leech 1948:452 (*partim*).

HOLOTYPE: "Lake of the Woods" (Ontario-Manitoba-Minnesota border) September, 1823, *LOST* (Locality discussion, Fox 1902:39; map, Barber 1928:16).

NEOTYPE: male; Harrison Lake, Fulton Co., Ohio, IX-27-1952, I. Slesnick, P. J. Spangler Collection, 1962; Type No. 69623, USNM.

LENGTH: 3.4-4.2 mm. WIDTH: 1.6-2.3 mm. COLOR: Dorsally yellow, center of pronotum may be somewhat darkened, head and center of clypeus black. ANATOMY: Punctation fine; prosternal crest low to medium height (fig. 38); mesosternal crest medium (fig. 39), posterior margin slightly convex, no distinct tooth at tip; clypeal emargination deep and wide, centrally flattened; abdominal notch medium sized (fig. 64), W/D = 2.2; male prosternal claws with distinct basal tooth, sharply bent; male genitalia (fig. 64) with medium lobe 0.6, dorsal strut 0.75 length of parameres.

DISCUSSION: Since the original type of *E. p. nebulosus* cannot be located, I have designated a Neotype from the center of the distribution of the subspecies. Some of Say's types are in LeConte's collection (MCZ) (Darlington 1961), but none of his *nebulosus* are from the type locality. The type locality, "Lake of the Woods", is a questionable locality for what has long been called *nebulosus* (fig. 84). However, this name has been used to refer to this form for 150 years. Of 9 specimens labeled "*P. nebulosus*" in LeConte's Collection (1850's and 1860's), 7 are what I am calling *E. p. nebulosus* and 2 are *E. sayi,* a more southern species. Also, the one specimen labeled "*E. nebulosus*" in Winter's 1920's collection is *E. p. nebulosus*.

E. p. nebulosus is distinguished from the sympatric *E. sayi* by its smaller, more triangular mesosternal crest (figs. 27, 39) and dark prosternum. Distinct punctation separates it from the similar but smaller *E. p. pectoralis*. The medium size mesosternal crest best separates it from *E. p. pygmaeus*. It also bears a strong resemblance to *E. ochraceus* which, however, has no prosternal crest and only a small rounded mesosternal crest.

Wilson (1923-24) lists this species as feeding on algae but laying its eggs on broad-leaf water plants such as *Potamogeton*. This agrees with Young (1954) who lists it as not found in temporary situations.

DISTRIBUTION: New England states to Colorado and Wyoming down to Texas and back through the Gulf states excluding Florida and Georgia. It is most abundant east of the Mississippi and above the Ohio River (fig. 84).

SPECIMENS EXAMINED: 1,826.

Enochrus (Methydrus) pygmaeus pectoralis (LeConte)
Figs. 34-37, 65, 82

Philhydrus (Philhydrus) pectoralis LeConte 1855:370

E. (Lumetus) nebulosus var. *pectoralis* (LeConte); Winters 1927:21.

E. (Methydrus) near *pectoralis*; Leech 1948:452 (Leech material examined).

E. (M.) pygmaeus complex, No. 2; Leech 1948:452 (Leech material examined)

(*non*) *Philhydrus maculifrons* Motschulsky 1859:179: as seen in LeConte 1863b:19; Horn 1873:127; Leng 1920:84; *fide* Leech 1948:452. (= *E. (M.) cristatus* (LeConte) based on description).

LECTOTYPE: male; gold dot (California), (Colorado River, California, description); Type No. 3089, *P. pectoralis* LeC. Col., LeConte Collection, MCZ. PARALECTOTYPE: gold dot (California) (missing head and prothorax); LeConte Collection, MCZ, see discussion below.

LENGTH: 2.7-3.6 mm. WIDTH: 1.6-2.0 mm. COLOR: Dorsally yellow to yellowish-brown, head and center of clypeus black; sides of mesosternal crest, prosternum, and epipleura often paler. ANATOMY: Elytral punctation not evident to very fine at 30X, only the typical strial rows of punctures evident; prosternal crest high and sharp (fig. 36); mesosternal crest medium, very acute (figs. 34, 35), anterior edge nearly vertical; clypeal emargination medium depth and smoothly rounded to flattened centrally (fig. 37); abdominal notch wide and deep (fig. 65), W/D=2.6; male protarsal claws with large bluntly pointed basal lobe which forms a narrow notch with free end of claw; male genitalia with median lobe gradually widened toward base (fig. 65), 0.6 length of parameres and dorsal strut narrowly triangular, somewhat over 0.75 length of parameres; tips of parameres very slender and weakly divergent.

DISCUSSION: This member of the *E. pygmaeus* complex has been at various times treated as a subspecies, a synonym, and a good species. Leech (1948) as well as Horn, Winters, and others felt it was a subspecies of either *E. nebulosus* or *E. pygmaeus*. In the United States, it seems to be quite distinct. The lack of apparent elytral punctation, smaller size, very high prosternal crest, acute mesosternal crest, and overall pale color separate it from all other members of the *pygmaeus* complex. In Mexico and southern Texas, however, *E. p. pectoralis* intergrades with the typical *E. p. pygmaeus* and what has until recently been called *E. nebulosus*. This would indicate that it is not a separate species, but a member of a complex of subspecies.

LeConte's series of *P. pectoralis* contains 4 more specimens which do not appear to qualify as paralectotypes. One bears only the label "*maculifrons*" but according to M. Thayer (MCZ) it is not in LeConte's handwriting. The other 3 specimens from Santa Ana River, S. California bear the date IV-23-79. Since it seems impossible that these could have been collected in 1779 but must be from 1879 they postdate the description.

DISTRIBUTION: California, Nevada, Arizona, New Mexico, and southwestern Texas, then down through central Mexico and Lower California (fig. 82).

SPECIMENS EXAMINED: 1,680.

Enochrus (Methydrus) aridus Gundersen, **new species**

Figs. 19-23, 68, 85

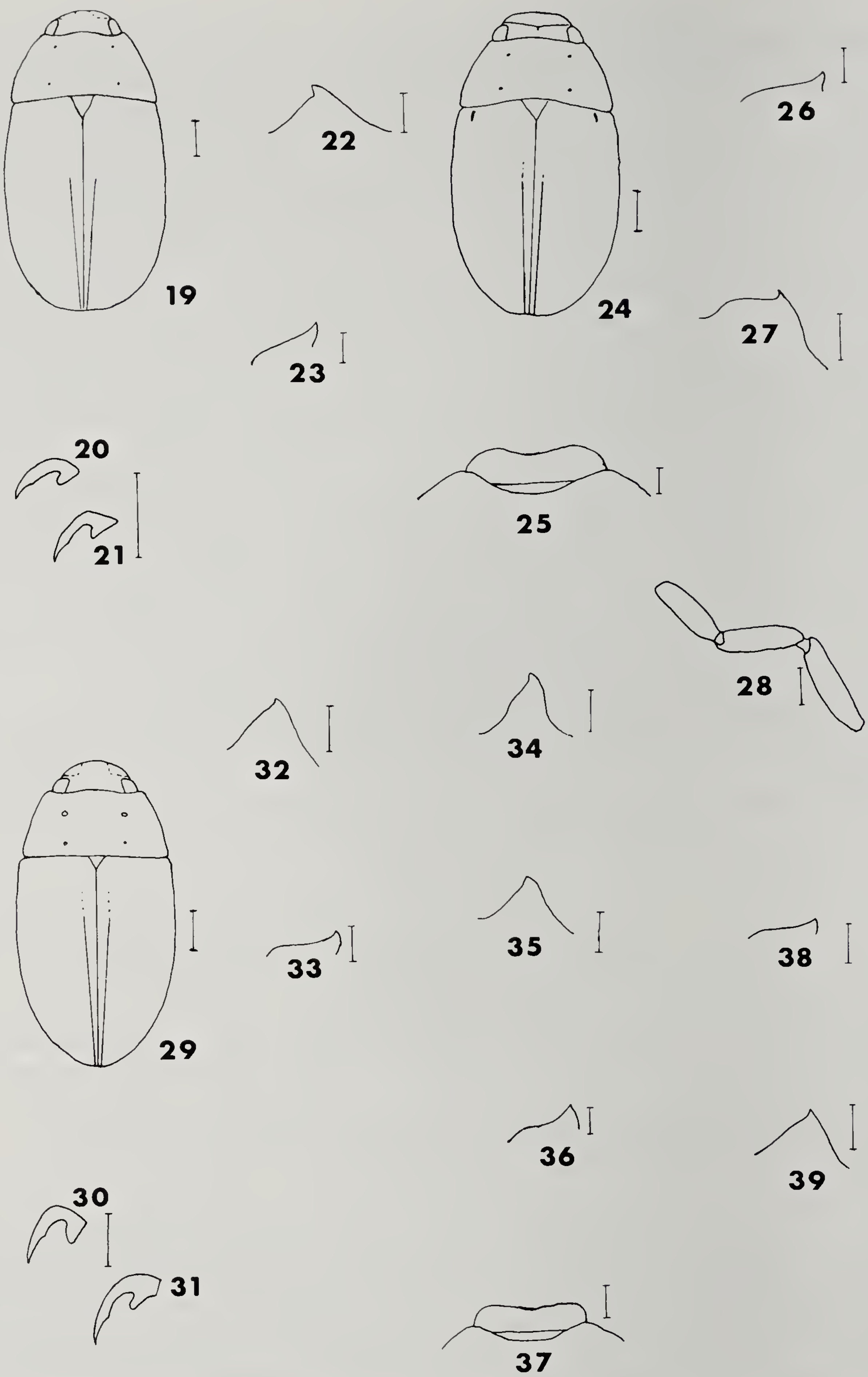
HOLOTYPE: male; Bear Canyon, Huachuca Mts., Arizona, V-8-1953, A. & H. Dietrich; Type No. 4424; Cornell. ALLOTYPE: female; Baboquivari Canyon, West side of Baboquivari Mts., Pima Co., Arizona VII-25-27-1952; Cornell. PARATYPES: 8, same data as holotype (1 author's collection); 5, same data as allotype (1 author's collection); 1, Baboquivari Mts., Arizona, XI-1-1934, Bryant Lot 104; Cornell.

LENGTH: 3.4-4.3 mm. WIDTH: 1.9-2.1 mm. COLOR: Dorsally yellow to brown, center of thorax somewhat, to much darker than wide anterior and lateral edges, center 1/2 to 1/3 of clypeus dark (Fig. 19), mesosternal crest and prosternum distinctly pale, epipleura same color to slightly darker than elytra, never dark brown. ANATOMY: Prosternal crest medium height (fig. 23); mesosternal crest a thin medium to large triangle (fig. 22), a distinct tooth at the tip, posterior edge nearly horizontal; clypeal emargination deep, smoothly rounded; abdominal notch small (fig. 68), W/D=2.0; male protarsal claws untoothed (figs. 20, 21); male genitalia slightly stouter than those of closely related species (fig. 68); median lobe wide, parallel-sided, 0.65, dorsal strut 0.75 length of paramere.

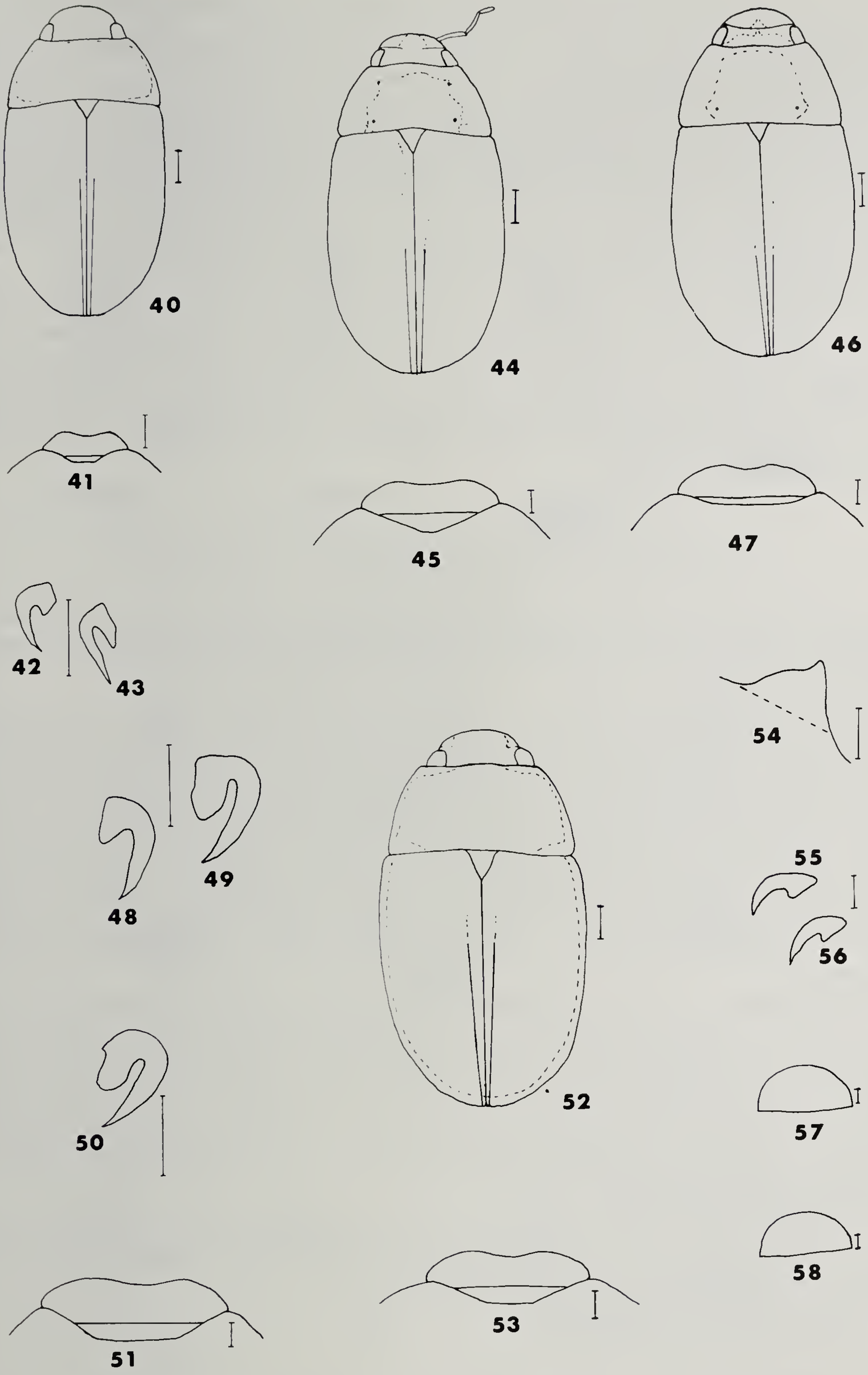
DISCUSSION: Most similar in size, color, and structure to *E. sayi* and *E. cristatus*. It has the prosternal and mesosternal crest similar to that of *E. sayi* but the dark pronotal center of *E. cristatus*. This combination of characteristics, along with a smaller abdominal notch, and stouter genitalia, mark this as a distinct species with a limited distribution.

DISTRIBUTION: Extreme southern portions of California and Arizona (fig. 85).

SPECIMENS EXAMINED: 57.



Figs. 19-39: 19-23, *Enochrus aridus* (19, habitus; 20, outer male protarsal claw; 21, inner male protarsal claw; 22, mesosternal crest; 23, prosternal crest); 24-28, *E. sayi* (24, habitus; 25, clypeal emargination; 26, prosternal crest; 27, mesosternal crest; 28, maxillary palpus); 29-33, *E. pygmaeus pygmaeus* (29, habitus; 30, outer male protarsal claw; 31, inner male protarsal claw; 32, mesosternal crest; 33, prosternal crest); 34-37, *E. p. pectoralis* (34, 35, mesosternal crest; 36, prosternal crest; 37, clypeal emargination); 38, 39, *E. p. nebulosus* (38, prosternal crest; 39, mesosternal crest); (scale line represents 0.5 mm, figs. 19, 24, 29; 0.2 mm, figs. 22, 23, 26, 27, 32-36, 38, 39; 0.1 mm, figs. 20, 21, 25, 28, 30, 31, 37).



Figs. 40-58: 40-43, *Enochrus hamiltoni* dark form (40, habitus; 41, clypeal emargination; 42, outer male protarsal claw; 43, inner male protarsal claw); 44-45, *E. hamiltoni* typical form (44, habitus; 45, clypeal emargination); 46-49, *E. hamiltoni* light form (46, habitus; 47, clypeal emargination; 48, outer male protarsal claw; 49, inner male protarsal claw); 50-51, *E. diffusus* (50, inner male protarsal claw; 51, clypeal emargination); 52-57, *E. interruptus* (52, habitus; 53, clypeal emargination; 54, mesosternal crest; 55, outer male protarsal claw; 56, inner male protarsal claw; 57, section across abdomen); 58, *E. perplexus*, section across abdomen; (scale line represents 0.5 mm, figs. 40, 44, 46, 52, 57, 58; 0.2 mm, figs. 41, 54; 0.1 mm, figs. 42, 43, 45, 47-51, 53, 55, 56).

Enochrus (Methydrus) negrus Gundersen, **new species**

HOLOTYPE: male; Glen Ranch, Brewster Co., Alpine, Texas, 1926, O. C. Poling Collector; Type No. 9375, CAS.

LENGTH: 3.4 mm. WIDTH: 1.8 mm. COLOR: Totally black, punctation indistinct. ANATOMY: Prosternal crest high and sharp, distinctly raised anteriorly; mesosternal crest large, sharp, anterior edge slightly concave; last two segments of maxillary palpi almost equal; clypeal emargination medium depth, flattened centrally; abdominal notch medium depth, W/D = 1.2; male protarsal claws with a distinct basal enlargement, forming a sharp angle with the rest of the claw; male genitalia essentially identical to those of *E. pygmaeus pectoralis*; median lobe broad, widened toward base, 0.63, dorsal strut narrowly triangular, 0.8 length of parameres.

DISCUSSION: The combination of anatomy plus the solid black color separate this from all other species. It is, however, very very close to *E. pygmaeus pectoralis* of which it may be a melanistic specimen. The type is in poor condition. Therefore, pending more collecting in southwestern Texas and Chihuahua and Coahuila, Mexico, I am placing it as the sole specimen of a new species.

Enochrus (Methydrus) sayi Gundersen, **new species**

Figs. 24-28, 67, 83

HOLOTYPE: male; Okeechobee, Florida, III-12-1943, Wm. Procter, Chamberlain Collection (Bears label *E. nebulosus*); Type No. 4425, Cornell. ALLOTYPE: female, same data as holotype, Cornell. PARATYPES: 39; same data as holotype, Cornell (4 author's collection).

LENGTH: 3.5-4.1 mm. WIDTH: 2.0-2.3 mm. COLOR: Dorsally yellow to pale brown except for vertex and central portion of clypeus (fig. 24), prosternum and mesosternal crest yellow to yellowish-brown, epipleura same color as elytra. ANATOMY: Prosternal crest very low, sharp, raised only at anterior end (Fig. 26); mesosternal crest large, posterior edge smoothly rounded almost horizontal toward front, a blunt anterior tooth (fig. 27); clypeal emargination smoothly rounded (fig. 25); abdominal notch medium width, shallow, W/D = 2.0 (fig. 67); maxillary palpi shorter and stouter than normal for group (fig. 28); male protarsal claws slightly enlarged basally; male genitalia (fig. 67) with median lobe wide, parallel-sided, 0.7, dorsal strut 0.75 length of parameres, ventrally visible portion of dorsal strut narrowly triangular.

DISCUSSION: *E. sayi* is distinguished from other United States members of this genus by the large posteriorly rounded mesosternal crest and very low prosternal crest (figs. 26, 27). The solid yellow dorsal color, and the pale epipleura, prosternum, and mesosternal crest separate it from the closest species, *E. pygmaeus pygmaeus,* and *E. p. nebulosus.* This widespread, abundant species probably will be found in many collections under *E. nebulosus* or *E. pygmaeus.*

DISTRIBUTION: Florida, central states which are drained by the Mississippi, Missouri, and Ohio Rivers, and the Great Lakes region to New England, not Minnesota or Manitoba (fig. 83).

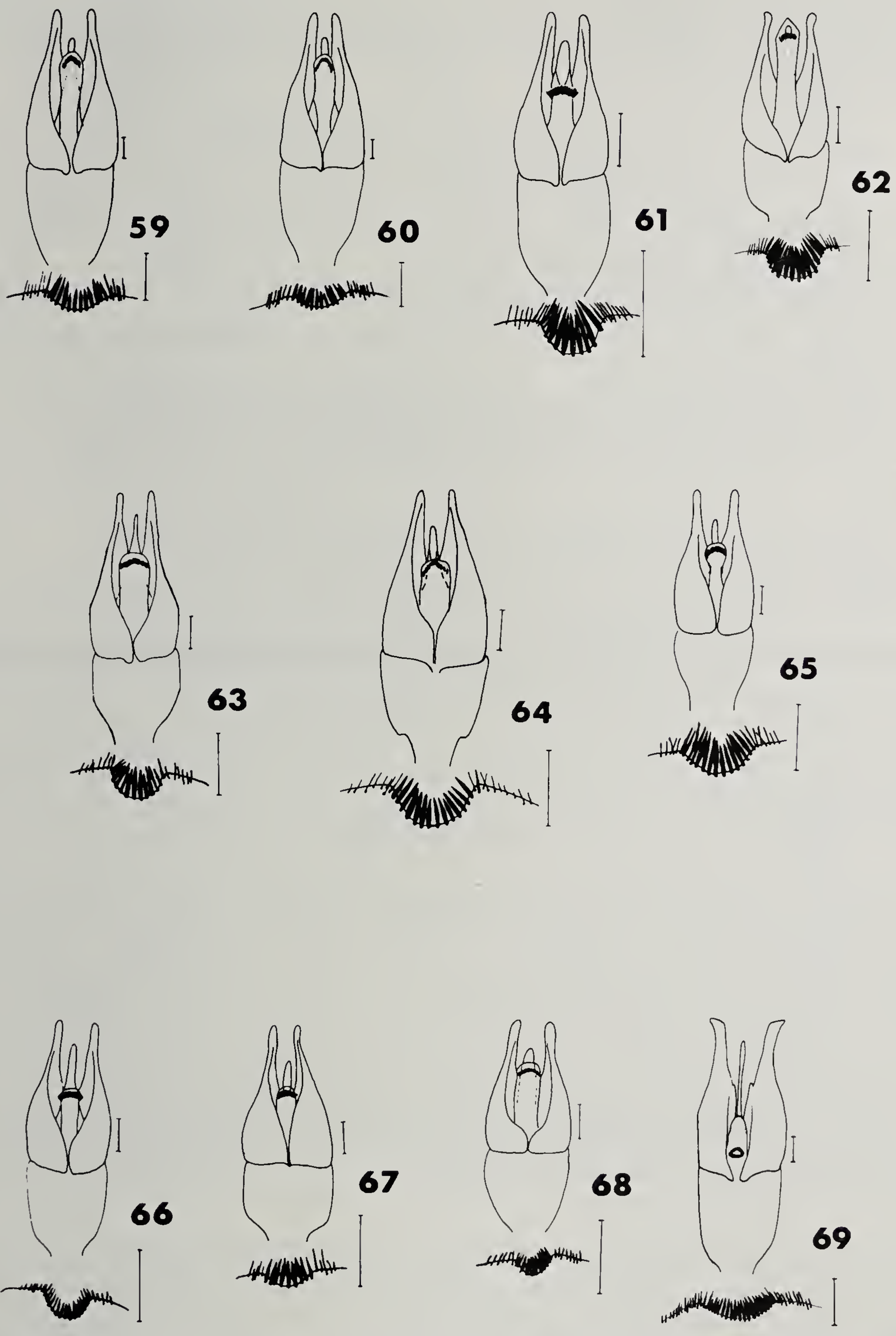
SPECIMENS EXAMINED: 241.

Enochrus (Methydrus) sharpi Gundersen, **new species**

Figs. 14-18, 66, 78

HOLOTYPE: male; Culiacan, Sinaloa, Mexico, VII-16-1963, P. J. Spangler collector; Type No. 69622, USNM. ALLOTYPE: female, same data as holotype, USNM. PARATYPES: 20 male; 12 female; same data as holotype, USNM and author's collection (3 males, 2 females).

LENGTH: 3.0-4.2 mm. WIDTH: 1.9-2.3 mm. COLOR: Dorsally yellowish-brown to brown, center of pronotum normally light but occasionally distinctly darkened, clypeus broadly black (fig. 14), prosternum and mesosternal crest paler to yellowish-brown, epipleura distinctly darker than elytra. ANATOMY: Punctation fine over whole dorsal surface; prosternal crest very low, sharp, raised slightly anteriorly (fig. 16); mesosternal crest extremely large, rectangular, thin, extending forward to between front coxae, posterior edge horizontal and straight (fig. 15); clypeal emargination fairly deep, smoothly rounded (fig. 18); abdominal notch narrow but deep (fig. 66), W/D=1.7; male protarsal claws untoothed (fig. 17); male genitalia with median lobe short, narrow, parallel-sided, 0.5, dorsal strut narrowly triangular, 0.8 length of parameres (fig. 66).



Figs. 59-69, *Enochrus* male genitalia and emargination in last abdominal sternite (abdominal notch): 59, *E. piceus piceus*; 60, *E. carinatus carinatus*; 61, *E. ochraceus*; 62, *E. pseudochraceus*; 63, *E. pygmaeus pygmaeus*; 64, *E. pygmaeus nebulosus*; 65, *E. pygmaeus pectoralis*; 66, *E. sharpi*; 67, *E. sayi*; 68, *E. aridus*; 69, *E. interruptus*; (scale line represents 0.2 mm).

Discussion: Very close to *E. aequalis* (Sharp); the mesosternal crest is long and the center of clypeus darkened like *E. aequalis* but punctation is a bit heavier, color slightly darker, and sutural stria not as distinct as described by Sharp (1882). Comparison of specimens of *E. sharpi* with the type of *E. aequalis* by P. J. Spangler and personal comparison with a homotype from the type series indicates that this is not *E. aequalis*. The very large rectangular mesosternal crest separates this from all other *Enochrus* from North and Central America.

Distribution: Central and southern Mexico and Puerto Rico (fig. 78).

Specimens examined: 170.

Enochrus (Lumetus) hamiltoni (Horn)

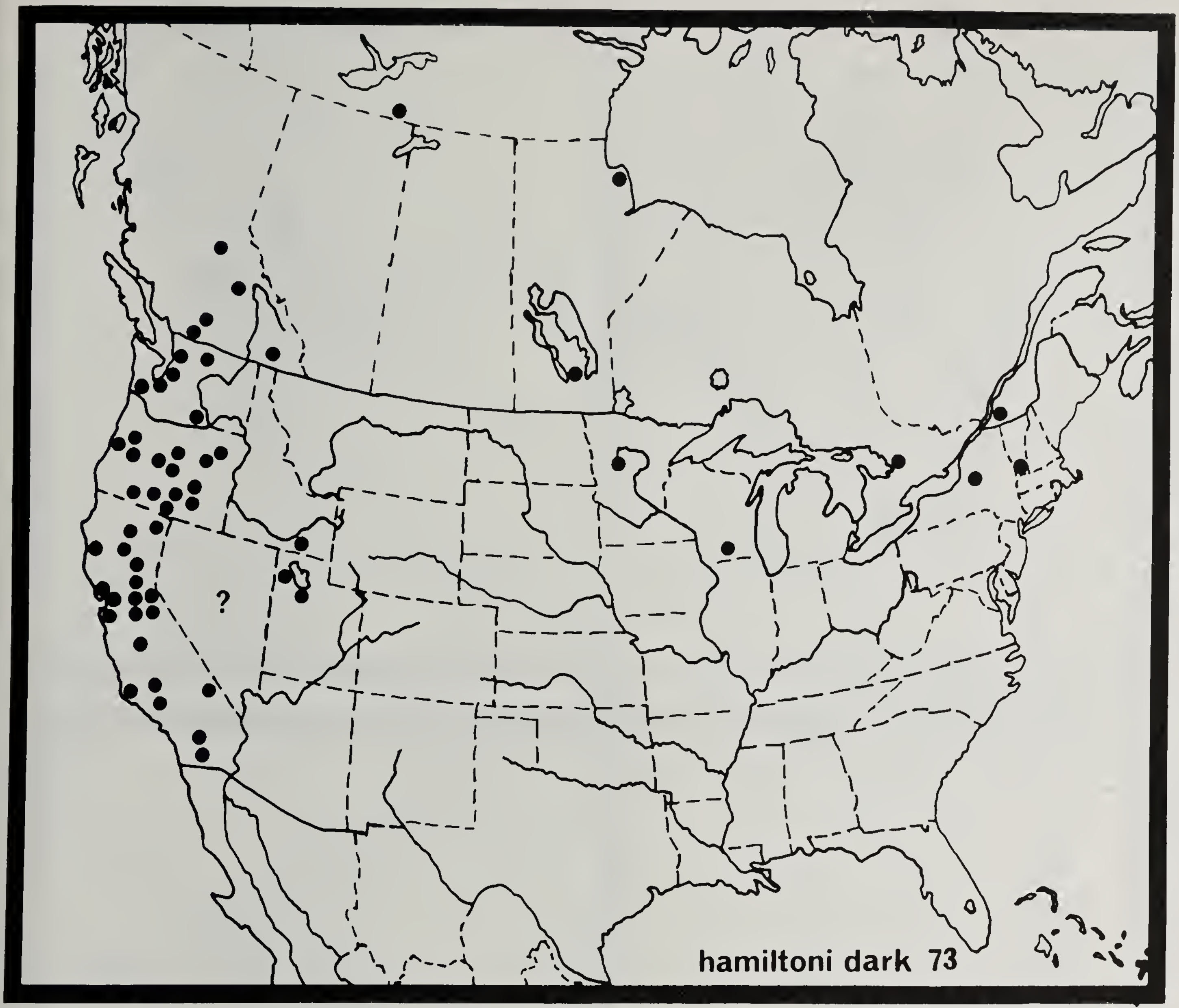
Figs. 40-49, 70, 71, 73-75

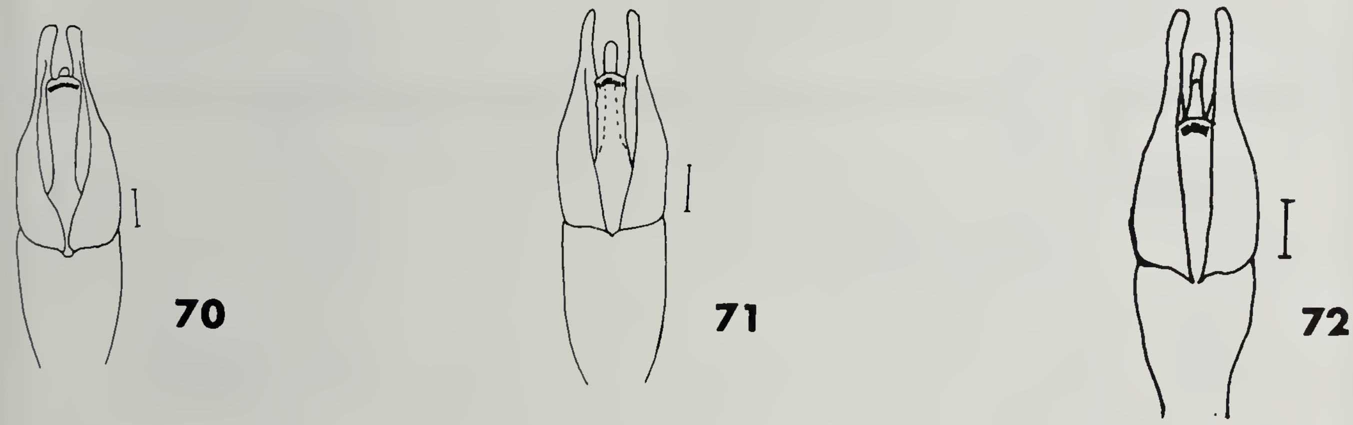
Philydrus (Philydrus) hamiltoni Horn 1890:249, Pl. III, Fig. 9.
Philhydrus hamiltoni Horn; Fall 1901:57.
Enochrus (Lumetus) hamiltoni (Horn); Zaitzev 1908:387.
Philhydrus conjunctus Fall 1901:217-218 (see type designation under *conjunctus*)
E. collinus Brown 1931:118 (Types in CNC, paratype examined).
E. horni Leech 1949:250-252 (Types at CAS, paratype examined).
E. hamiltoni pacificus Leech 1949:253-255 (Types at CAS, paratype examined).
E. h. pyretus Leech 1949:255 (Types at CAS, paratype examined).
E. diffusus Winters 1927:23 (*partim*) *fide* Leech 1949:253.
Philhydrus lividus Walker 1866:310-319 (*nec.* Forster) *fide* Miller 1964:71.

Lectotype: male; New Jersey ("coast", description), Horn Collection, H-9215; Type No. 2976-1, MCZ (formerly ANS Phila.). Paralectotypes: 3, Canada, 2976-4, 8, 10; 1, California (northern, description), 2976-5; 1, Oregon, 2976-7, 2, no data; and 2, Canada, these are probably 2976-2, 3, 9; 1 Massachusetts, listed in description. E. T. Cresson, Jr. quoted in Leech (1949) says, "Of the typical series besides the type, we have: two N.J., 2 Can., one Tyngs 5/8-72 of which one N.J. the two Can. and the Tyngs, are labeled paratypes." I cannot explain this discrepancy. Margaret Thayer of MCZ verified and provided an interpretation of the present state of the type series.

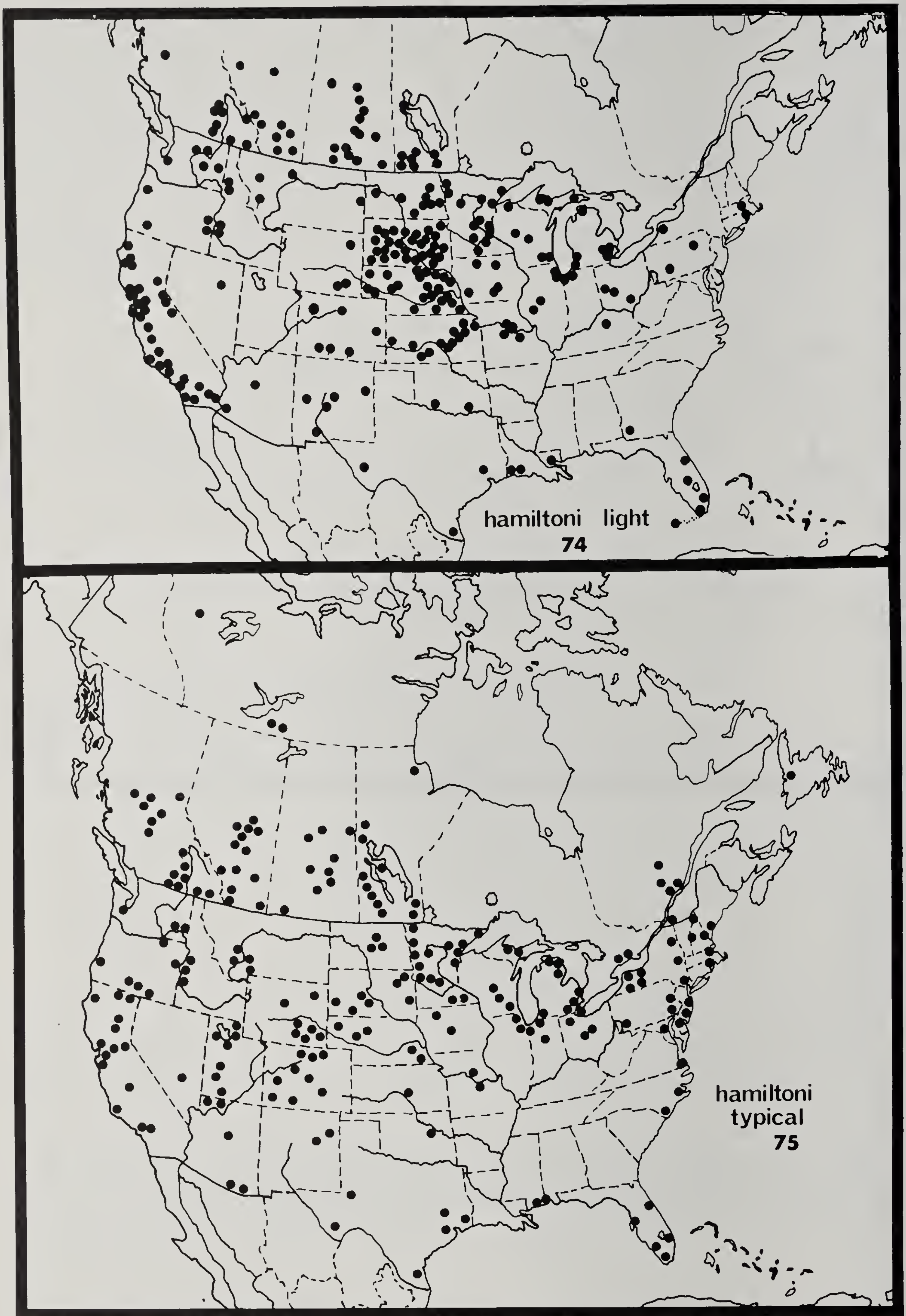
Length: 4.3-6.1 mm. Width: 2.3-3.1 mm. Color: Dorsal color highly variable; elytra yellow to black; pronotum totally light, centrally dark, or almost totally black (figs. 40, 44, 46). Anatomy: Prosternum not carinate; mesosternal crest a broad triangle, either smoothly pointed or a blunt tooth at tip; clypeal emargination medium depth to deep, smoothly rounded (when deep, very center may be straight) (figs. 41, 45, 47); last abdominal segment not emarginate; male protarsal claws heavily and unequally lobed, the inner claw (figs. 43, 49) with lobe pointed to rounded and set at a slight to sharp angle with the free portion of claw, the larger the lobe the sharper the angle and narrower the slot between claw and lobe, lobe of the outer claw distinctly smaller (figs. 42, 48); mesotarsal claws equally lobed, lobe slightly smaller than that of the outer protarsal; metatarsal claws unlobed; male genitalia typical (figs. 70-71), median lobe 0.70-0.74 and dorsal strut 0.80-0.82 length of slender-tipped parameres, dorsal strut slightly to greatly exceeding median lobe.

Discussion: After studying material from the total range of this species, I am recognizing 3 color forms: dark (*conjunctus*—form, almost totally black), light (*horni*—form, totally light), and typical (*hamiltoni*—form, only pronotal center dark). The dark form is limited to the West Coast with isolated populations along the Canadian-United States border. The other 2 forms are common over most of the United States and southern Canada.

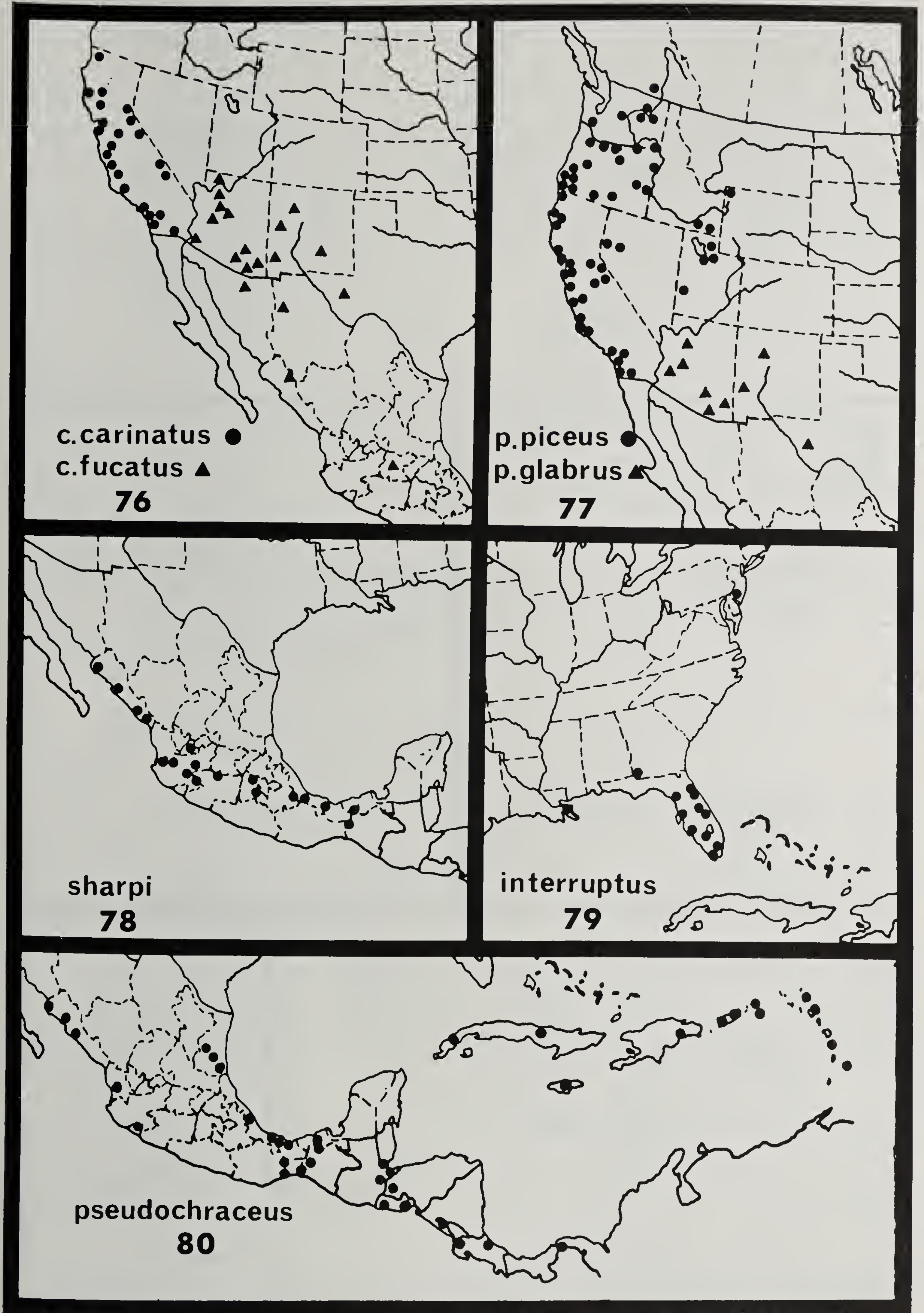




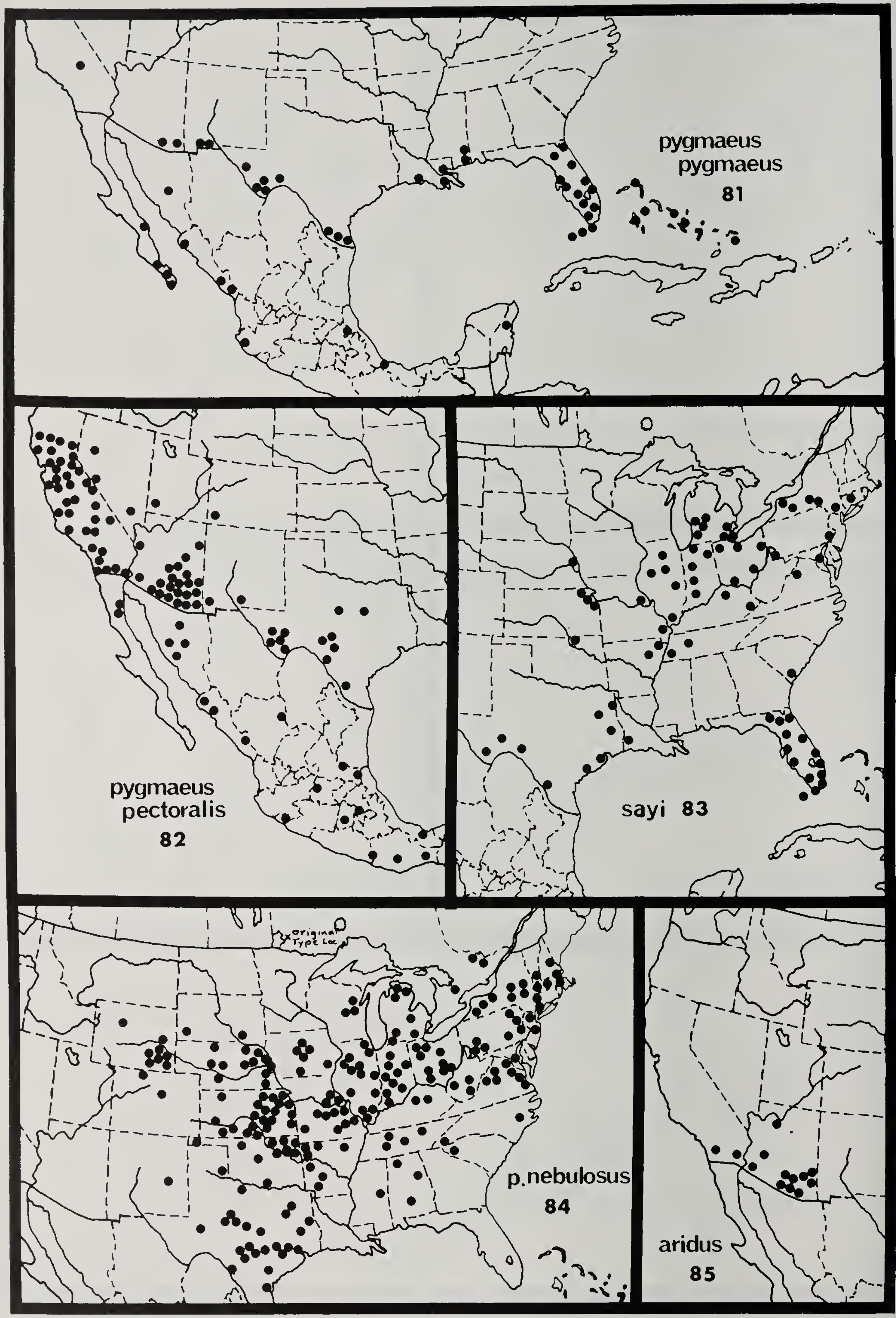
Figs. 70-73, *Enochrus* male genitalia and distribution map: 70, 71, *E. hamiltoni*, 72, *E. diffusus*; 73, *E. hamiltoni* dark form; (scale line represents 0.2 mm).



Figs. 74-75, *Enochrus hamiltoni* distribution maps: 74, light form; 75, typical form.



Figs. 76-80, *Enochrus* distribution maps: 76, *E. carinatus carinatus* and *E. c. fucatus*; 77, *E. piceus piceus* and *E. p. glabrus*; 78, *E. sharpi*; 79, *E. interruptus*; 80, *E. pseudochraceus*.



Figs. 81-85, *Enochrus* distribution maps: 81, *E. pygmaeus pygmaeus*; 82, *E. p. pectoralis*; 83, *E. sayi*; 84, *E. pygmaeus nebulosus*; 85, *E. aridus*.

I feel *E. hamiltoni* is a polymorphic species which at this time cannot be split into subspecies. Local populations of this species are often distinct in proportions of the claws, relative lengths of dorsal strut and median lobe of the male genitalia, and color pattern; but these differences vary independently, making subspecies separation impossible. The 3 forms are most distinct in the northeastern states, from Minnesota east, and eastern Canada. Possibly glaciation in this area or some other phenomenon separated populations long enough for some genetic isolation. I recommend distinguishing the forms when possible. Further study may discover characters, at least in the east, allowing subspecific separation.

The typical form is not likely to be confused with any other Nearctic species. The light form can be confused with *E. diffusus,* which has the central portion of the clypeal emargination broadly flattened (fig. 51), a significantly longer dorsal strut (fig. 72), and larger lobes on the male protarsal claws (fig. 50). The dark form is superficially similar to other nearly to totally black species. *E. piceus* and the *E. cinctus* group are all much more highly convex. *E. perplexus* and *E. interruptus* differ in having at least a fringe of golden bristles at the center of the last abdominal sternite, which is lacking in all *Lumetus.*

DISTRIBUTION: Throughout the United States and Canada. The dark form is limited to the western states with scattered populations across Canada and from Minnesota to Vermont (figs. 73-75).

SPECIMENS EXAMINED: 7,000.

TYPE SPECIMEN DESIGNATIONS

Many of the species in this genus were described by Horn, LeConte, Melsheimer, and Zimmermann. Series of cotypes are in their collections and in most cases lectotypes have not been designated. I have designated lectotypes and paralectotypes from their series for the following species, as well as for several already discussed in this article.

Philhydrus blatchleyi Fall 1924:85-86 (=*Enochrus (Methydrus) blatchleyi* (Fall)).

HOLOTYPE: male; Dunedin, Florida, IV-3-1923, Fall collector; Type No. 24005, Fall Collection, MCZ. PARATYPES: 1 female; Dunedin, Florida, IV-6-1922; 2 same, IV-2-1923; 1 Tarpon Springs, Florida, III-31-1922; 5 (2 male, 2 female) St. Petersburg, Florida, IV-6-1923; 1 same, IV-4-1922; 1 same, III-26-1923: Fall Collection, MCZ. Last specimen in series from St. Petersburg bears the date III-28-1925 so cannot be a paratype.

Philydrus (Philydrus) californicus Horn 1890:248 (=*Enochrus (Methydrus) californicus* (Horn)).

LECTOTYPE: male; California (probably northern, description), Horn Collection, H 9314; Type No. 2974, MCZ (formerly ANS Phila). PARALECTOTYPE: sex unknown; same data; Horn Collection, MCZ.

Philhydrus conjunctus Fall 1901:217 (=*Enochrus (Lumetus) hamiltoni* (Horn)).

LECTOTYPE: male; Lake Tahoe, California, '98; Type No. 24006, Fall Collection, MCZ. PARALECTOTYPES: 1 male, 1 female, same data; Fall Collection, MCZ.

Philydrus consors LeConte 1863a:24 (=*Enochrus (Methydrus) consors* (LeConte)).

LECTOTYPE: female; Louisiana; Type No. 3103 *P. consors* LeC., LeConte Collection, MCZ. The other 5 specimens in the series are from Florida and New Hampshire so cannot be part of the type series.

Philhydrus (Philhydrus) cristatus LeConte 1855:370 (=*Enochrus (Methydrus) cristatus* (LeConte)).

Holotype: female; gold dot, California (San Diego, description); Type No. 3086, LeConte Collection, MCZ. This is the only specimen listed in the description so it is the holotype. The 3 marked "Cal." in LeConte's Collection, therefore, are neither paratypes nor paralectotypes.

Hydrobius cuspidatus LeConte 1878:597-598 (=*Enochrus (Enochrus) cuspidatus* (LeConte)).

Lectotype: male; Lake Tahoe, California, Crotch collector; Type No. 3112, LeConte Collection, MCZ. This is the only specimen matching the locality and collector listed in the description. The specimens labeled "Cal." (1) and gold dot (California) (1) in LeConte's Collection therefore are neither paratypes nor paralectotypes.

Philhydrus (Philhydrus) diffusus LeConte 1855:371 (=*Enochrus (Lumetus) diffusus* (LeConte)).

Lectotype: sex unknown; green dot (California and Nebraska, description); Type No. 3087[4], LeConte Collection, MCZ. Paralectotypes: 3 green dot; LeConte Collection, MCZ. All other specimens in LeConte's Collection were collected at localities not listed by LeConte.

Philhydrus elongatulus Fall 1924:85 (=*Enochrus (Methydrus) sublongus* (Fall)).

Holotype: female; Dunedin Florida, IV-6-1922, Fall collector; Type No. 24007, Fall Collection, MCZ. Paratypes: 1 Dunedin, Florida, IV-2-1923; 1 Tarpon Springs, Florida, III-31-1921; 1 St. Petersburg, Florida, IV-4-1922, MCZ. All others in the series were collected in 1925 or localities not listed by Fall.

Philhydrus (Helochares) fimbriatus Melsheimer 1844:101 (=*Enochrus (Methydrus) perplexus* (LeConte)).

Lectotype: male; pink dot, Middle States (Pennsylvania, description); Type No. 32358, 2nd specimen in series in LeConte's Collection, MCZ. Paralectotypes: female; same data, 1st specimen in series; LeConte Collection, MCZ. All other specimens in series are from areas other than Pennsylvania (4th is *Cymbiodyta semistriatus*).

Philhydrus (Philhydrus) lacustris LeConte 1855:369-370 (=*Enochrus (Methydrus) ochraceus* (Melsheimer)).

Holotype: female; faded blue dot (Lake Superior), (Eagle Harbor, Lake Superior, Michigan, description); Type No. 3088, LeConte Collection, MCZ. This is the only specimen and bears the label "*Philydrus lacustris* Lec.=*Enochrus ochraceus* Melsh/see Fall 1924:89." This should read :87.

Philhydrus limbalis Melsheimer 1844:101 (=*Enochrus (Methydrus) cinctus* (Say)).

Lectotype: sex unknown; no data, (Pennsylvania, description), does bear a Ziegler label; Type No. 32359, Melsheimer-Ziegler Collection, MCZ. Paralectotype; bears same data as lectotype, MCZ.

Philhydrus ochraceus Melsheimer 1844:101 (=*Enochrus (Methydrus) ochraceus* (Melsheimer)).

Lectotype: sex unknown; orange (brick red) dot, Southern States: (Pennsylvania, description); Type No. 32360, MCZ. There is no specimen of *E. ochraceus* is Melsheimer's Collection. However, in a letter from John L. LeConte to Alexander Agassiz (Darlington 1961) LeConte says he has in his collection "all unique types" of Melsheimer's species. LeConte (1855:371) also states the type is very immature (teneral). The first specimen in LeConte's series of *E. ochraceus* is teneral but is labeled with an orange (brick red) dot (see above). This refers to a more southern area than listed by Melsheimer (Pennsylvania), but the only other teneral specimen in his series is from Florida (series examined by Margaret Thayer, MCZ, April, 1977). I feel this must be Melsheimer's original type specimen with a wrong locality tag on it. It should have been a pink dot for the Middle States. Therefore, I am designating it as the lectotype of *E. ochraceus*.

Philhydrus (Philhydrus) perplexus LeConte 1855:371 (=*Enochrus (Lumetus) perplexus* (LeConte)).

Lectotype: male; yellow dot, Central Valley or Western States (New York, Illinois, Lake Superior, Nebraska, description); Type No. 3090[3], LeConte Collection, MCZ. PARALECTOTYPES: 1 green dot (Neb., Kans., N.Dak., S.Dak., Okla., Colo., Wyo., Mont.); 2 pink dot (Middle States; Md., Del., N.Y., N.J., Pa., Conn.?, R.I.?); LeConte Collection, specimens 4, 1, and 2 respectively, MCZ. All other specimens in the series are either from other localities or are not *E. perplexus.*

Philhydrus reflexipennis Zimmermann 1869:250 (=*Enochrus (Lumetus) reflexipennis* (Zimmermann)).

LECTOTYPE: male; New Jersey (7422.2); Type No. 3140, LeConte Collection, MCZ. PARALECTOTYPES: 1 New Jersey; 1 Delaware; 2 pink circle (Middle States, see *E. ochraceus* for list); 1 New York; LeConte Collection, MCZ.

Philydrus simplex LeConte 1863a:24 (=*Enochrus (Methydrus) ochraceus* (Melsheimer)).

LECTOTYPE: sex unknown; Louisiana, Mr. Ulke; Type No. 3104, *P. simplex* LeC., LeConte Collection, MCZ. PARALECTOTYPE: Louisiana; Type No. 3104 *simplex* 2, LeConte Collection, MCZ.

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BIOLOGY AND HABITS OF *HIPPOPSIS LEMNISCATA* (COLEOPTERA: CERAMBYCIDAE)[1,2]

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ABSTRACT

Information on the life cycle of *Hippopsis lemniscata* (Fabricius), a cerambycid attacking common ragweed, *Ambrosia artemisiifolia* L., is presented. The beetle is univoltine in northeastern Ohio, with peak adult emergence occurring during a 3-4 wk period from early July to early August. Eggs are deposited singly within the pith of the stem. First- to fourth-stage larvae bore into and feed upon the pith. Mature larvae overwinter in a state of temperature-induced quiescence within the stem. Pupation occurs within the stem in a specially constructed pupal chamber. Despite extensive feeding, pith destruction by larval *H. lemniscata* does not appear to affect the competitive or reproductive capacities of *A. artemisiifolia.*

INTRODUCTION

The ragweeds (*Ambrosia* spp.: Compositae) are serious agricultural weeds and medically important, aeroallergenic pollen-producers responsible for late-summer and fall hayfever throughout much of North America. Surveys of the phytophagous insect faunas of selected ragweed species have revealed the existence of a diverse assemblage of insects, many of which are poorly known biologically (Harris and Piper 1970, Goeden and Ricker 1974a, b, 1975, 1976a). The paucity of detailed biological and ecological information on *Ambrosia* insects has prompted several recent investigations (Gilstrap and Goeden 1974, Goeden and Ricker 1976b and Piper 1975, 1976, 1977).

Common ragweed, *A. artemisiifolia* L., is attacked by a variety of phytophagous Coleoptera in northeastern Ohio (Piper 1970). One such associate is the cerambycid, *Hippopsis lemniscata* (Fabricius). Since very little was known about this beetle, a study of its biology and habits was initiated.

The genus *Hippopsis* Serville (Cerambycidae: Lamiinae) contains but 1 Nearctic and Neotropical species, *H. lemniscata.* In North America the beetle is restricted to the eastern United States, and in South America to Brazil (Leng and Hamilton 1896).

Craighead (1923) and Hack (1935) presented life history notes on *H. lemniscata.* Larval, pupal, and adult descriptions and/or illustrations were provided by Craighead (1923), Knull (1946), and Peterson (1951). Larval feeding is not restricted entirely to *Ambrosia* spp. Additional host plants reported in the literature include *Melothria pendula* L. and *Bidens* sp. (Leng and Hamilton 1896), *Coreopsis* sp. (Blatchley 1910), *Erigeron ramo-*

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[1] Approved as Technical Article 13493, Texas Agric. Exp. Stn. Series.

[2] Manuscript reviewed by H. R. Burke (Texas A & M University) and E. G. Linsley (University of California, Berkeley).

sus (Walt.) (Craighead 1923), and *Vernonia interior* Small (=*baldwinii* Torrey) (Schwitzgebel and Wilbur 1942).

Biological observations on *H. lemniscata* are based on rearings initiated by adults, larvae, and pupae collected in or near the city of Kent (Portage County) in northeastern Ohio. Laboratory rearings were carried out at room temperatures of 20°-25°C, 50%-60% RH, and a 12/12 hr photoperiod.

Life History

Hippopsis lemniscata has been recorded from Michigan (Gosling and Gosling 1976), east to New York, south to Florida and west to Texas (Leng and Hamilton 1896). Adults are slender, 10-13 mm long and dark reddish brown, with 4 yellowish brown longitudinal stripes on the head and pronotum and 3 stripes on each elytron.

Although a few adults were collected in late June, the beetles were most abundant in July and early August, gradually decreasing in number as summer progressed. Adults reared from pupae lived from 1-3 mo, the females living slightly longer than males. There was 1 generation annually in northeastern Ohio. The seasonal distribution of the various life stages is shown in Fig. 1.

The adults generally remained closely associated with *A. artemisiifolia* and only rarely were observed on other vegetation. During the hottest time of the day, the beetles were relatively inactive, resting on the lower shaded portions of ragweed stems. Although adults are strong fliers, they were reluctant to fly and either fell to the soil beneath the plant when disturbed or remained on the stem and stridulated in a manner like that described by Linsley (1961). Both sexes fed extensively upon the epidermis and underlying stem tissue. However, the feeding activity did not result in any detectable plant damage.

The premating period was not determined. Mating was observed most frequently in nature during the morning or evening hours on the lowermost portion of the host plant. No overt precopulatory behavior was exhibited by the male. The male mounted the female from behind by moving directly forward and onto her dorsum. His front tarsi clasped her humeri and the middle tarsi grasped either her hind coxae or abdomen caudad of the hind legs. The male's hind legs touched the plant surface. Both male and female antennae were directed forward, those of the female being positioned between the male's slightly divergent antennae. Having attained the proper position (Fig. 2), the male's abdomen was directed ventrocephalad and coupling was achieved with the extruded female genitalia. While in copula, the male occasionally appressed his mandibles and/or maxillary palpi to the female's pronotum, scutellum, or basal elytral margin. The female generally remained quite passive during copulation which lasted anywhere from 15-60 min. Repeated matings between the same male and female occurred frequently in the laboratory, both before and after oviposition had commenced. A male was capable of mating with different females and a female accepted different males.

The preoviposition period (from emergence to 1st deposition of eggs) of 7 females averaged 14.5 days. These females each laid an average of 1 egg/day (range 0-10) over a 43 (range 32-53) day period. Total eggs produced/female ranged from 20-60, the average being 42.

Oviposition was observed at various times during the day, but occurred more commonly during the late afternoon and evening hours. The female usually selected a suitable oviposition site on the uppermost third of a stem. She positioned her body parallel to the stem with the head directed downward (Fig. 3) and then proceeded to gnaw a funnel-shaped hole ca. 1.0-1.3 mm in diameter through the stem epidermis and cortex (Fig. 4). Immediately after completing the egg niche, the female reversed her position on the stem so that the head now pointed upward. She bent the abdomen downward, extended the ovipositor slightly, and probed for the hole. Upon locating the aperture, the female inserted the ovipositor and deposited a single egg in the pith. The egg was positioned parallel to the stem's upright axis. Eggs were found in the field from mid-July to mid-September. The incubation period of 20 eggs held under laboratory conditions averaged 6 (range 5-7) days.

The first-stage larva of *Hippopsis* is equipped with thoraco-abdominal hatching spines (Gardiner 1966). The chorion was ruptured as a result of peristaltic movement by the larva. Extrication of the abdominal segments occurred prior to removal of the head from the chorionic remnant.

The neonate larva tunnelled the pith located in the apical portion of the stem. The increased girth of the late second- and third-stage larva, coupled with increased stem narrowness, prohibited further upward movement and feeding. When this occurred, a larva reversed its direction and fed toward the base of the plant. The third- and fourth-stage larva fed on the pith until it was consumed completely from the apex to ground level.

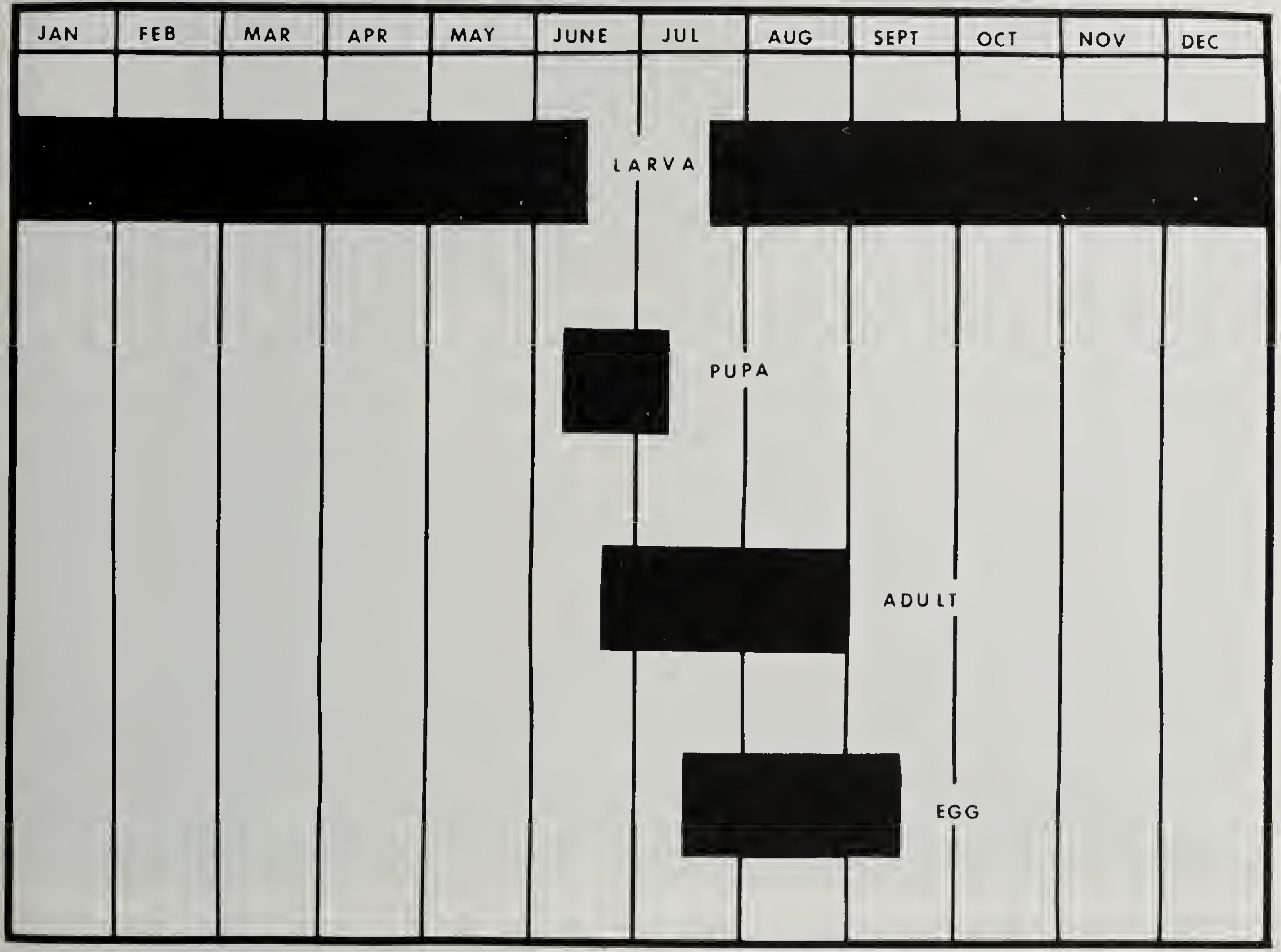


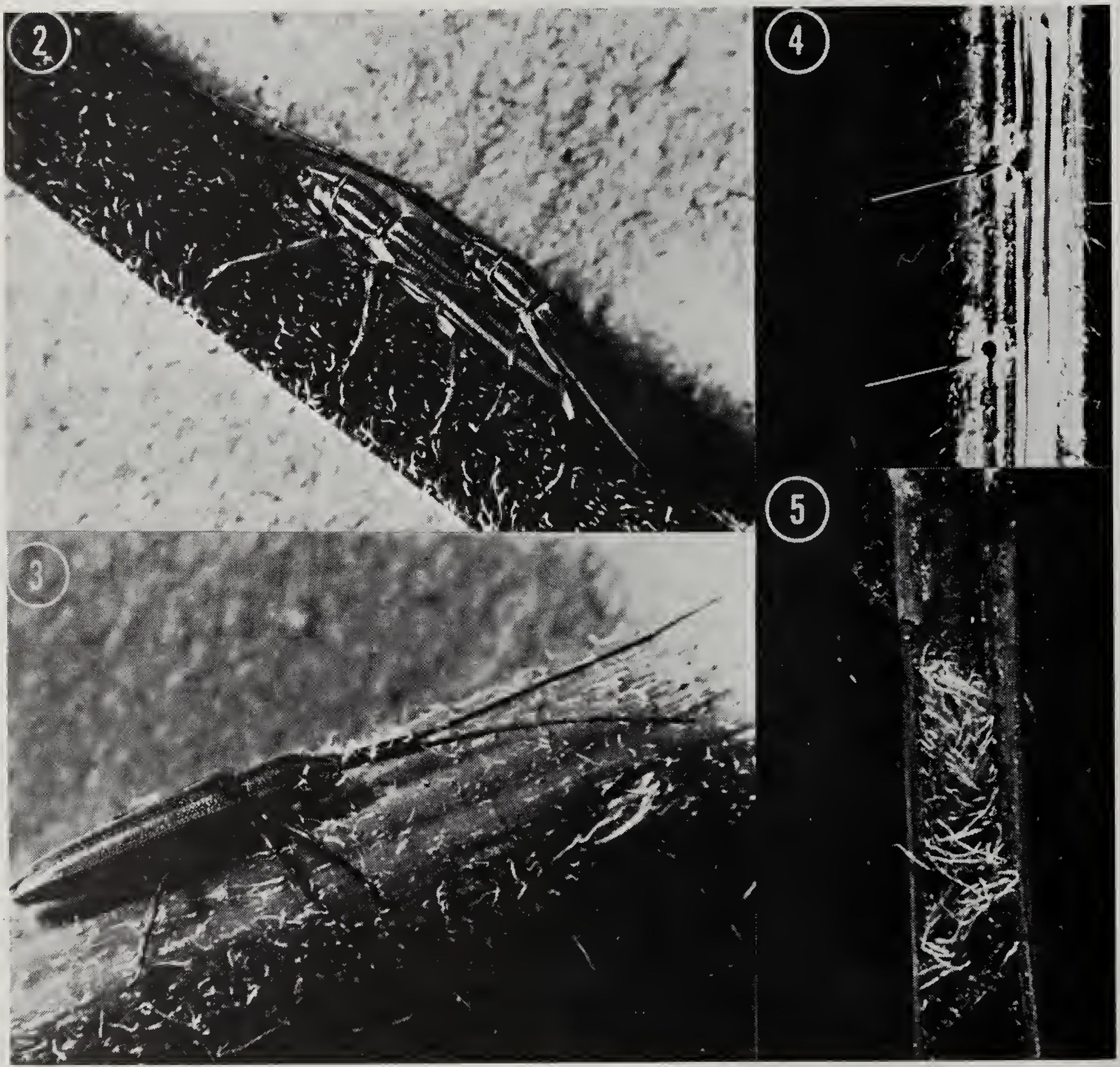
Fig. 1. Seasonal history of *Hippopsis lemniscata* on *Ambrosia artemisiifolia* in Ohio.

The length of the larval gallery ranged from 30-61 cm, the length being governed by plant height. Even though feeding was extensive, pith destruction did not appear to affect the competitive or reproductive capacities of *A. artemisiifolia*. The first larval stadium was completed in 7-11 days, the second in 6-10 days, the third in 6-10 days, and the fourth, under laboratory conditions only, in 10-17 days.

Field observations indicated that there was only 1 larva/stem, even though several eggs may have been deposited/stem.

H. lemniscata larvae exhibited cannibalistic tendencies in the laboratory. This behavioral characteristic undoubtedly explains why only a single larva reaches maturity in nature.

In late October and November with the onset of cool temperatures, the fourth-stage larva prepared a pupal chamber within the hollowed-out ragweed stem. The chamber, situated in the basal third of the stem, consisted of a section of the linear larval gallery partitioned off with an upper and



Figs. 2-5. *Hippopsis lemniscata*: 2) Mating posture of adults; 3) Female gnawing an oviposition hole; 4) Section of stem showing a partially excavated hole (top) and a completed hole (bottom); 5) Pupal chamber frass and fecula plug.

a lower 2-3 cm long plug of fecula and excelsior-like frass (Fig. 5). The larva overwintered in a state of temperature-induced quiescence within the chamber.

Pupation occurred during June and early July. In nature, a larva always pupated head upward within the chamber. The pupa was very active and capable of rapidly ascending and descending its chamber. Duffey (1953) suggested that this behavior may allow the pupa to avoid unfavorable conditions such as waterlogged stems, fungal growth, predators, and parasites. No predation on or parasitism of any life stage was recorded in the field during the study but this does not preclude the possibility of its existence.

The duration of the pupal period averaged 11 (range 9-14) days. Sequential body coloration changes were observed throughout the pupal period. The eyes were the first structures to become pigmented, followed by the mandibles, tarsal claws, antennae, elytra, and head. The teneral adult was fully pigmented and sclerotized within 24-36 hr. The adult gnawed a subcircular to circular hole through the wall of the stem and escaped.

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* * *

PILOT STUDY FOR A BIOLOGICAL SURVEY OF THE INSECTS OF CANADA

Have you received a questionnaire?

The Entomological Society of Canada has been awarded a contract by the Canadian Government to conduct a Pilot Study for a Biological Survey of the Insects of Canada. This project is intended to establish the foundations for a continuing biological survey, and a major aim is to assess the resources and needs of Canadian research in the identification, distribution, and biology of insects (including arachnids and other related forms).

Four types of questionnaire have therefore been distributed. If any readers have information to contribute on relevant resources or needs and were overlooked in the original mailing, we would be very pleased to receive requests for the applicable questionnaires as listed below.

(1) To individual entomologists, to ascertain the location of personnel and programs, and to seek information on the state of knowledge in Canada of their taxonomic or ecological groups of interest.

(2) To resource managers, environmentalists, and other users of information on insects, to ascertain their present and future needs for entomological information.

(3) To directors of institutions conducting entomological research in Canada, to ascertain programs and facilities.

(4) To curators of collections in Canada and elsewhere, to ascertain the whereabouts of significant holdings of Canadian arthropod material.

Secretariat, Biological Survey Project
202—1316 Carling Avenue
Ottawa, Ontario
K1Z 7L1

IDENTIFICATION OF THE LARVAE OF *ANISODACTYLUS RUSTICUS* AND *CALATHUS GREGARIUS*, GROUND BEETLES FOUND IN SOUTH DAKOTA CROPLANDS (COLEOPTERA: CARABIDAE)

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Abstract

Drawings of the larval head capsule and a description of the apical margin of the frontal piece for each species are given as a supplement to previously published aids in identification of larvae of carabids of cropland.

The material presented here is a supplement to papers published earlier (Kirk 1972, 1975) as aids in identification of carabid larvae. *Anisodactylus rusticus* (Say) and *Calathus gregarius* Say are commonly found on cropland in South Dakota. Of the 141 species of adult carabids that I found, I have been able to associate the larvae of 32 with their adult stage through rearing.

G. E. Ball, Department of Entomology, University of Alberta, identified representative adults of these species, and Betty J. Dupraz, formerly laboratory technician here, aided in rearing the specimens in the laboratory.

Anatomical Features of the Apical Margin of the Frontal Piece

Anisodactylus rusticus (Say). Nasale with base originating slightly behind apical margin of frons, 3-4 denticles on each side of shallow median notch; adnasale smoothly rounded, projecting as far forward as denticles of nasale, slope of adnasale denticulate at base. Examined: 4. Width: –; 1.5-1.6; – mm (Fig. 1).

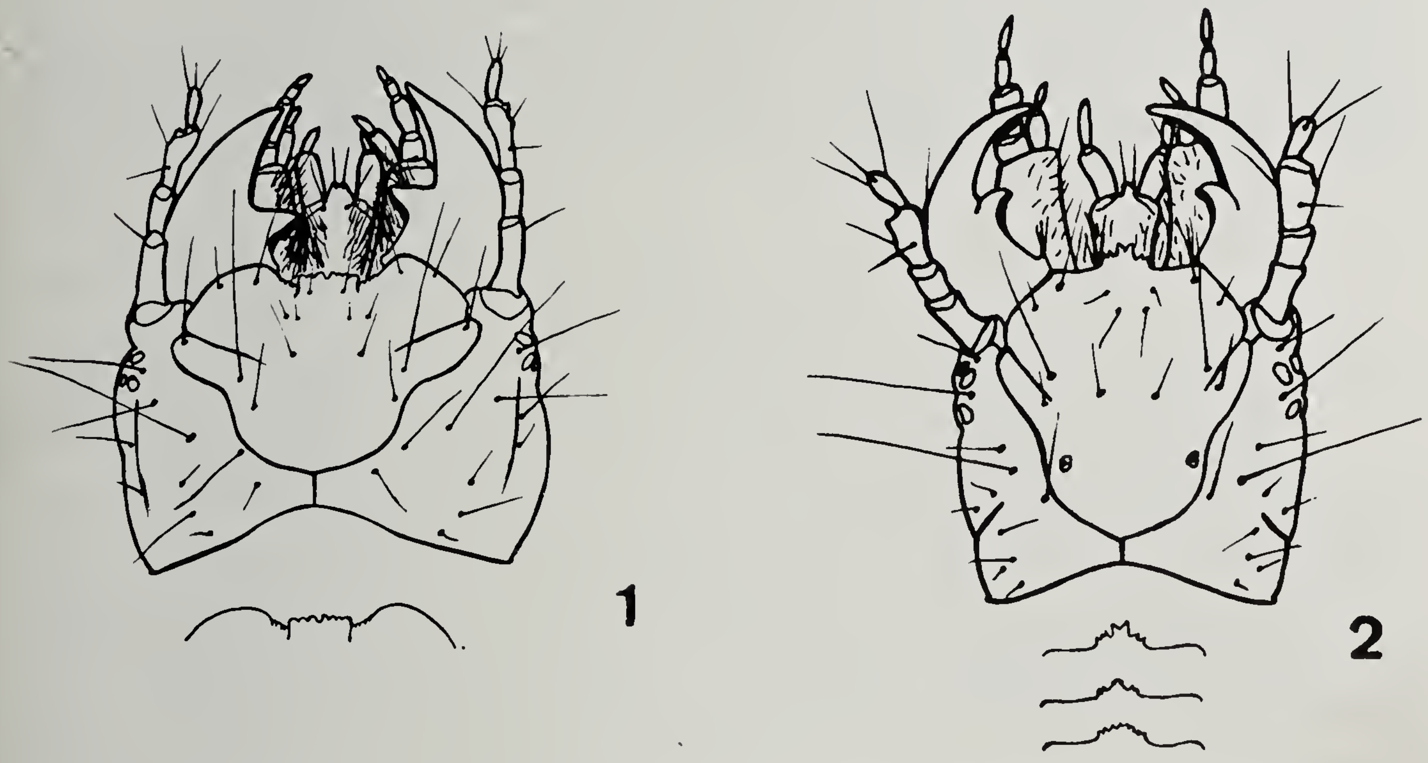

Fig. 1-2. Dorsal views of heads of 1) *Anisodactylus rusticus,* 2nd stage, and outline of apical margin of the frontal piece; 2) *Calathus gregarius,* 1st stage, and outlines of 3 variations of apical margin of the frontal piece.

Calathus gregarius Say. Nasale with teeth varying from large bifurcate median tooth and 2-3 smaller teeth on either side, to arcuate with 7-8 smaller teeth; adnasale flat and not projecting forward. Examined: 9. Width: 0.5-0.6; 0.7-0.8; – mm (Fig. 2).

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* * *

EDITORIAL NOTICE

The editor's office herewith announces a number of steps taken to improve and streamline editorial service, speed up production of the *Bulletin*, and expedite processing of orders for separates.

1. Effective immediately, Robert D. Gordon joins the editorial staff as associate editor, with primary responsibility for taking initial action on submitted manuscripts including procurement of external reviews.
2. Also effective immediately, billing statements for page charges and separates will be prepared by the treasurer based on data supplied by editor at time galley proof is returned to printer. These statements will be available to the managing editor before an issue is published, so that orders for separates can be processed immediately.
3. Beginning September 1, 1977, order forms for separates sent with galley proof to authors will reflect new, uniform rates @ $9.00 per 100 separates for articles up to 2 pages in length, plus $4.00 per 100 for each additional 2 pages or fraction thereof.
4. Beginning with the March, 1978 issue, separates will be available in units of 100 and 200 only, and they must be ordered in advance.

With these actions, it is anticipated that production of the enlarged *Bulletin* will remain economical, that it will be returned to an acceptable schedule, and that long delays in processing manuscripts will be abolished.

—D. R. W.

* * *

A NEW SPECIES OF *PSAMMODIUS* FROM SAND DUNES OF CALIFORNIA (SCARABAEIDAE: APHODIINAE: EUPARIINA)

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Psammodius doyeni Cartwright, **new species**

Holotype male: Oval, 3.0 mm long, greatest width 1.7 mm; moderately shining, testaceous, head slightly reddish. Head convex; clypeus moderately emarginate, limiting angles rounded, lateral borders arcuate to and around inconspicuous genae, latter with few fine hairs; surface tuberculate, tubercles transversely elongate before middle, rounded above, separated by about their diameter; occiput smooth. Pronotum 1.2 mm wide, 0.65 mm long, convex; sides straight behind narrowly rounded anterior angles, rounded and weakly crenate posteriorly, partly hidden when viewed from directly above; sides very finely margined, fimbriate, with long, fine hairs near anterior angles, hairs much shorter around basal border; surface of pronotum smooth and shining with anterior transverse impressed row of close, moderately fine punctures not quite reaching impunctate anterior pronotal angles, another row parallel with basal margin reaching inward from lateral fovea almost to scattered median group each side of lightly impressed midline, a few scattered punctures between the 2 transverse lines and along base. Elytra globular, length 1.9 mm, width 1.7 mm, with very weak basal border broken by striae, lateral margins with very fine, long hairs, approximately 0.2 mm in length, striae fine, deep, strial punctures very slightly crenating intervals. Mesosternum finely shagreened, with traces of fine median carina. Metasternum rather deeply depressed at middle, length of metasternal midline and width of post-coxal plates subequal; very finely alutaceous outward to sides. First 2 abdominal sterna with transverse rows of short to moderate hairs; 3 following sterna with single transverse rows of long, fine, erect light colored hairs. Pygidium bordered apically with long fine hairs. Middle and hind femora each with complete posterior marginal line and row of 7 or 8 moderately long fine hairs close to line, femora also with row of hairs twice as long along anterior edge; posterior femora twice as wide, more convex than middle femora. Hind tibia slightly longer than twice the apical width, anteapical transverse ridge slightly interrupted at internal edge; terminal spurs very short, heavy, long spur twice as long as short spur and subequal to first tarsal segment; entire tarsus short and compact, length about equal to apical width of tibia. Apical spurs and tarsus of middle tibiae long and slender; long spur longer than first 2 tarsal segments combined and equal to apical width of tibia.

Allotype female: Length 2.9 mm, width 1.7 mm. Same data as holotype. Sexes apparently distinguishable only by dissection.

Type-locality: CALIFORNIA: *San Luis Obispo Co.,* Dune Lakes, 3 mi. S Oceano, 4 March 1977, in damp sand on North facing slopes, J. Doyen, Lot DL77-3. Holotype and allotype returned to University of California, Berkeley, to be deposited on indefinite loan at the California Academy of Sciences, San Francisco, California.

Paratypes (56): CALIFORNIA: *San Luis Obispo Co.,* same data as holotype (45); same locality, 20-III-1974, Doyen & Powell (2); same locality, 1-V-1975, J. Doyen, Lot DL75-4, *ex* stabilized dunes (2); same except 23-II-1975, Lot 0275-2, *ex* stabilized dunes (1); same except ex *Haplopappus-Lotus* litter (2); Pismo St. Beach, North Campground, 24-II-1975, J. Doyen, Lot PB75-2 (2); Morro Bay, sand spit, 2 mi. S Morro Bay, 5-III-1977, Rude & Doyen, Lot M077-3, in sand under Calcite maritima (1). *Monterey Co.,* Beach at Little Sur R., 17-I-1976, J. Doyen (2). Paratypes in U. S. National Museum of Natural History and University of California, Berkeley. The paratypes vary from 2.6 to 3.0 mm in length.

Remarks: *Psammodius doyeni* will key to couplet 23 on page 419 in my revision of American *Psammodius,* Proceedings U. S. National Museum, vol. 104, no. 3344, 1955. In this couplet it will key to *Psammodius mcclayi,* from which it differs as follows:

1. Dark reddish brown; pronotal punctures deep, moderately numerous; row of 4 or 5 punctures each side in remnant of intervening row between the 2 distinct transverse pronotal furrows.... .... *P. mcclayi* Cartwright
1′. Light reddish testaceous; pronotal punctures weak, slightly smaller, fewer in number; very few punctures between the 2 transverse furrows .... *P. doyeni* Cartwright, new species

On direct comparison the pronotum of *P. doyeni* appears to be slightly shorter than that of *P. mcclayi* in relation to overall length.

Psammodius doyeni is another of the previously undescribed species of insects found in Dr. Alan Hardy's study of the desert sand dunes of California. It is named after Dr. John T. Doyen, collector of the type specimens.

* * *

THE FAMILY PHENGODIDAE IN THE UNITED STATES

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It might interest readers in the United States that I have published a "Contribution to a revision of the Fam. Phengodidae" (Ent. Arbeiten Museum Frey, Tutzing, 27, 1976, pp. 415-524). This publication affects the nomenclature of several species occurring in the United States.

The examination of the tentorial pit obliged me to create the genus *Distremocephalus* for the following species of *Mastinocerus*: *M. texanus* Lec, *M. californicus* Van Dyke, and *M. opaculus* Horn.

Cenophengus longicollis is described from Texas.

The genus *Paraptorthodius* Schaeffer is revalidated, and characters are given for separation from *Cenophengus.*

Correction

A regrettable mistake occurred in my article on the genus *Phengodes* (Coleop. Bull. 29, 1975, p. 250). It should read:

Subgenus *Phengodella*

12(1′). Elytra more or less extensively brown only at base, remainder from dark to black .... *P. frontalis* Lec.
12′. Elytra concolorous, from piceous to black 13

The key remains unchanged otherwise.

DESIGNATION OF HOLOTYPES AND LECTOTYPES FOR SPECIES DESCRIBED BY THOMAS L. CASEY IN THE SUBTRIBE PTEROSTICHI (COLEOPTERA:CARABIDAE:PTEROSTICHINI)[1]

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ABSTRACT

Holotype and Lectotype designations are made for 26 species of Carabidae described by Thomas L. Casey in the tribe Pterostichini and in the following genera: *Gastrosticta, Lophoglossus, Loxandrus, Pterostichus, Poecilus*. The male genitalia of species for which figures have not been previously published are presented.

Professor Carl Lindroth (1975) adequately discussed the history and present status of the beetle collection of Thomas L. Casey, one of the most prolific writers among early North American amateur coleopterists. Over the years Lindroth designated holotypes and lectotypes (most of which were officially designated in 1975) for about 3/4 of the 1376 species names created by Casey in the Carabidae. Recently, several other workers also have designated type material among the Carabidae in the Casey collection.

This paper serves to complete designation of holotypes and lectotypes for species presently placed in the subtribe Pterostichi. The arrangement of the information follows that used by Lindroth (1975) except that categories (g) and (h) are added and species are listed in alphabetical order. Category (g) designates a specimen number label that has been added to each specimen. The specimen number is used to facilitate data storage and retrieval of information. Category (h) lists the figure number of the male genitalia illustrated in this paper. The following is quoted from Lindroth's paper (1975).

"Arrangement of Information

The original genus names used by Casey were followed __________ .

Then, under each taxon, the following information is given:

(a) reference to the original description;

(b) number of specimens labeled as "Type" or "Paratype" (by L. L. Buchanan);

(c) locality label of the "Type", often in abbreviated form, as used by Casey. (The symbol "L", = Levette collection, was often doubtfully translated in the description as meaning Colorado or Indiana);

(d) possible disagreement between "Type" and Casey's original description;

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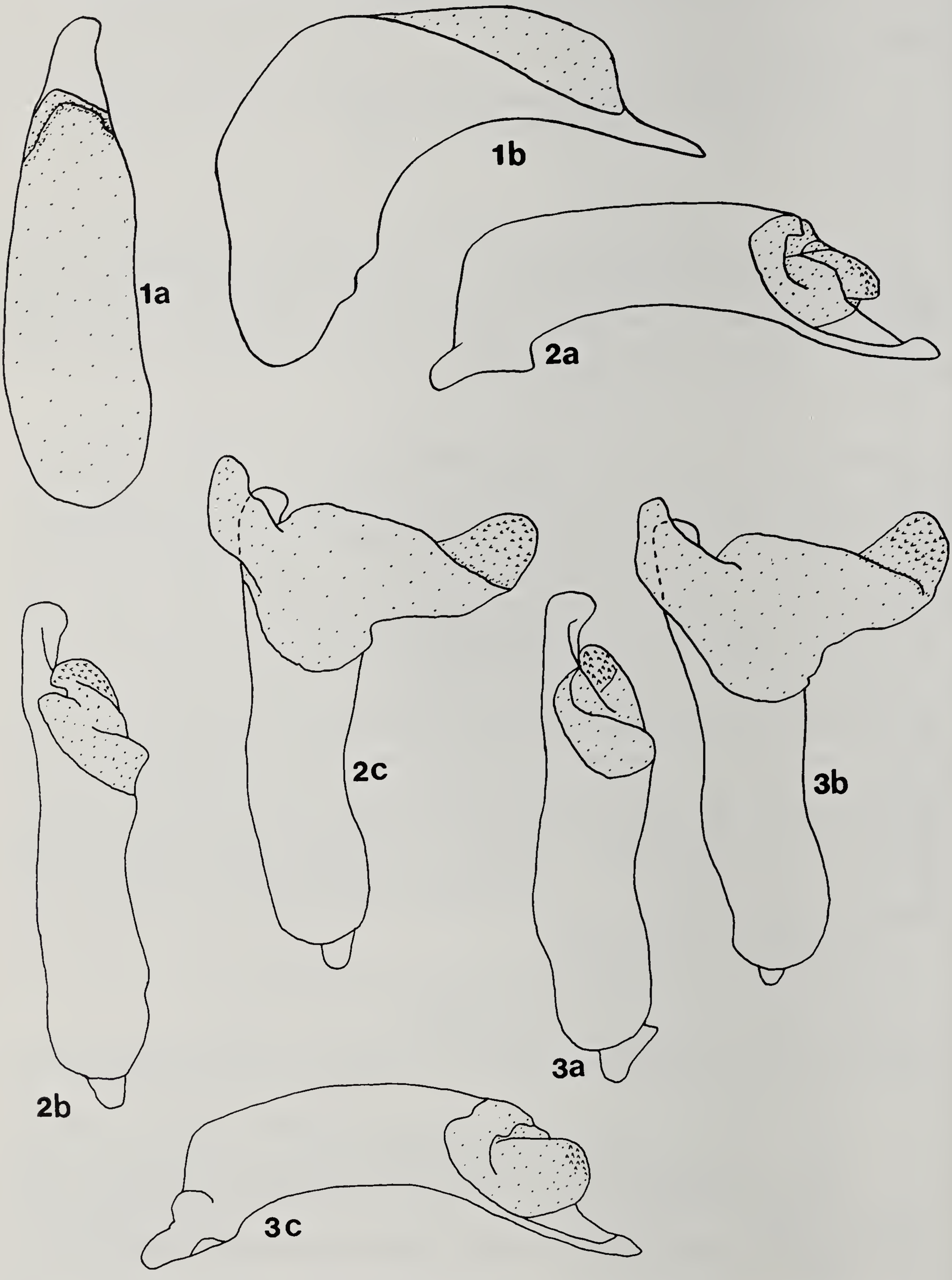
[1] Published with the approval of the Director of the Arkansas Agricultural Experiment Station.

(e) decision whether a Holotype or a Lectotype should be designated;
(f) valid name according to present opinion (as a rule with reference to a paper, where Casey's name was synonymized).
[(g) UAIC computer reference number].
[(h) Figure number of male genitalia].



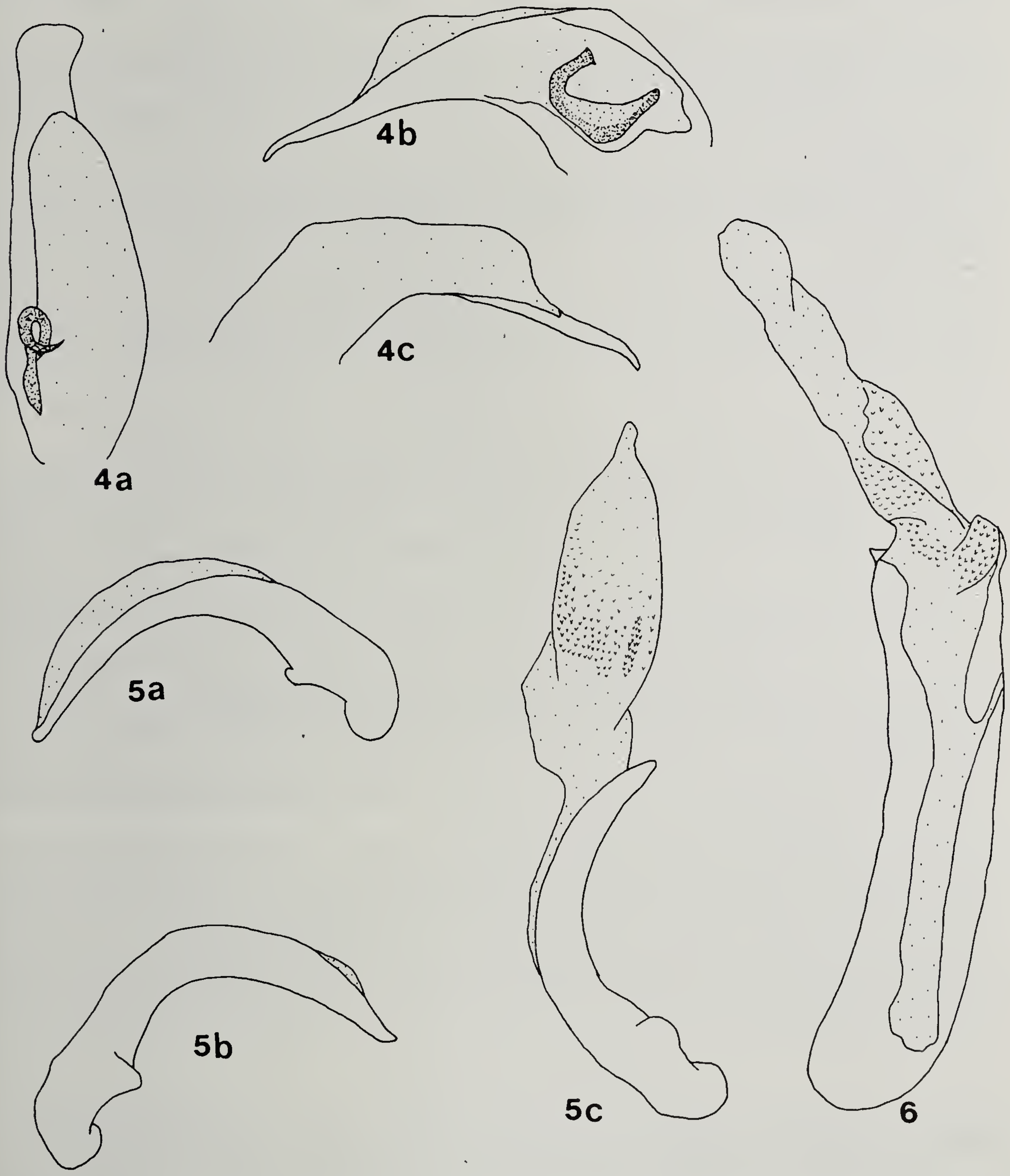
Figs. 1-3, male aedeagus: 1, *Gastrosticta amnicola* (1A Dorsal; 1B Left lateral); 2, *Lophoglossus bispiculatus* (2A Left Lateral; 2D Dorsal; 2C Dorsal, sac everted); 3, *L. illini* (3A Dorsal; 3B Dorsal, sac everted; 3C left lateral).

"As *Holotype* a specimen is available only under the condition that Casey himself expressly stated the original to have been based on a single individual. Under all other circumstances, even if the species is represented by a single specimen in Casey's collection, a *Lectotype* must be selected.

"The 4 kinds of "types" have been abbreviated as a single boldface letter, as follows: T = "Type"; P = "Paratype"; according to L. L. Buchanan's labeling (and almost without exception conspecific).

"H = Holotype: L = Lectotype; according to my own [Robert T. Allen] decision. Paralectotypes have not been marked."

I thank the Board of Trustees of the University of Arkansas for granting me a 6 months off-campus duty assignment during which time this work was conducted. I also thank Dr. T. L. Erwin of the U.S. National Museum of Natural History for providing space for me to work during this time.



Figs. 4-6, male aedeagus: 4, *Pterostichus puta* (4A Dorsal; 4B right lateral; 4C left lateral); 5, *P. snowi* (5A right lateral; 5B left lateral; 5C left lateral, sac everted); 6, *Peocilus louisinus*, dorsal, sac everted.

THE SPECIES

Gastrosticta subacuta (1918:373). Female T. Texas. T = L. UAIC 44069.

G. amnicola (1918:372). Male T. 1 P. Missouri (Casey lists St. Louis in the original description). T = L. UAIC 44070. Fig. 1.

Lophoglossus bispiculatus (1913:146). Male T. No locality label (Casey lists Indiana as the type locality in the original description). T = L. UAIC 44075. Fig. 2.

L. illini (1913:145). Male T. 1 male 1 female P. Illinois. T = L. UAIC 44076. Fig. 3.

Loxandrus accelerans (1918:385). Female T. 1 P. Texas (Casey lists Galveston in in the original description). T = L. UAIC 44047.

L. breviusculus (1924:80). Female T. Dunedin, Florida, W.S.B. Coll., 12-4-17. T = H. UAIC 44048.

L. cervicalis (1918:385). Male T. Sarasota, Florida, W.S.B. Coll., 1-31-1911. T = L (Allen, 1972, wrongly listed this specimen as the Holotype; figures 130A,B,C,D). UAIC 44065.

L. cincinnati (1924:80). Male T. 1 P. Cincinnati, Ohio, VII-? T = L. (Allen, 1972, wrongly listed the T specimen as a Holotype; figure 116). UAIC 44068.

L. collucens (1918:382). Female T. Texas (Casey lists Houston in the original description). T = L. UAIC 44049.

L. comptus (1918:387). Female T. Dunedin, Florida, W.S.B. Coll., 4-5-1915. T = L. UAIC 44050.

L. contumax (1918:388). Female T. Florida. T = L. UAIC 44051.

L. cursitans (1918:387). Female T. Dunedin, Florida, W.S.B. Coll., 3-5-17. T = L. UAIC 44052.

L. concinnus (1918:391). Female T. 1 P. Dunedin, Florida, W.S.B. Coll., 2-26-17. T = L. UAIC 44053.

L. fulgens (1918:388). Female T. Vicksburg, Mississippi. T = L. UAIC 44055.

L. lateralis (1918:381). Female T. Sarasota, Florida, W.S.B. Coll., 3-4-1911. T = L. UAIC 44056.

L. limatus (1918:383). Female T. Washington, D.C., 15-10. T = L. UAIC 44057.

L. ludovicianus (1918:383). Female T. Cane River, Louisiana. T = L. UAIC 44058.

L. mandibularis (1918:382). Male T. D.C. T = L. *L. rectus* (Say) (Allen, 1972; figures 98A,B,C). UAIC 44063.

L. mundus (1918:385). Female T. LaBelle, Florida, W.S.B. Coll., 2-27-14. T = L. UAIC 44059.

L. parvicollis (1918:389). Female T. Texas (Casey lists Galveston in the original description). T = H. UAIC 44060.

L. scitus (1918:388). Male T. 1 P. Dunedin, Florida, W.S.B. Coll., 2-1-1913. T = L. *L. floridanus* LeConte (Allen, 1972; figures 122A,B). UAIC 44066.

L. suturalis (1918:384). Female T. Dunedin, Florida, W.S.B. Coll., 2-20-18. T = L. UAIC 44061.

L. vulneratus (1918:390). Female T. No locality label (Casey lists Indiana in the original description). T = L. UAIC 44062.

Pterostichus puta (1913:135). Female T. 1 P. Texas. P = L. (I have selected the paratype specimen because it is a male). UAIC 44073. Fig. 4.

P. snowi (1913:137). Male T. 1 male, 1 female P. Arizona, San Bernadino Ranch, Cochise Co. 3750 ft., Aug., F. H. Snow. T = L. UAIC 44079. Fig. 5.

Poecilus lucublandus ssp. *louisinus* (1924:76). Male T. St. Louis, Missouri. T = H. UAIC 44078. Fig. 6.

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NOTES ON *CAFIUS OPACUS* LE CONTE WITH EXTENSIONS OF RANGE (COLEOPTERA: STAPHYLINIDAE)

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University of California, Riverside, CA 92521

Cafius opacus LeConte is rare in collections and has been mentioned in the literature only a few times. A few recently collected specimens considerably extend its known range.

C. opacus was originally described by LeConte (1863) from "San Diego, California, under seaweed on the beach". It was next mentioned by Casey (1885) in the notes following his description of *Phytosus* (=*Bryobiota*) *bicolor.* Casey stated "This species [*Bryobiota bicolor*] is extremely abundant under the densely packed seaweed thrown up on the shores of the inner harbor in the Spring of the year; occurring with it and also in great abundance were *Cafius (Remus) decipiens* Lec., *Motschulkium sinuaticolle* Matth., *Phycocoetes testaceus* Lec., and, in less numbers, *Cafius (Remus) opacus* Lec.". Horn (1894) reported it from "San Diego, California, and Baja, California (LeConte)". Moore (1937) said "Mr. Albert Watson found a specimen of this species on carrion at the beach at Torrey Pines in April". Moore and Legner (1973) speculated that this and some other southern California seashore species may ordinarily be found abundantly along the poorly explored Pacific shores of Baja California.

Until recently the only specimens known to us have been a small series in the collection of the California Academy of Sciences taken by E. C. VanDyke at Point Loma, California, and a specimen collected by Ian Moore at La Jolla, California, on 22 November, 1950. The latter was crawling up the wall of a cave on the floor of which was a large mass of decaying seaweed, and from whose mouth were flying many of the usually scarce *Cafius sulcicollis* LeConte and *Aleochara arenaria* Casey.

With the exception of the mention of "Baja California" by Horn, all of the preceding localities are within the city limits of San Diego, California.

Among material sent to us by Vincent Lee of San Francisco is a specimen of *C. opacus* from Socorro Dunes, Baja California, Norte, Mexico, 17 July, 1974, collected by R. H. Hardon, V. Lee, and W. E. Savary. This record extends the known range of the species about 200 miles south.

On 18 October, 1976, R. E. Orth collected six *C. opacus* at Refugio State Beach, Santa Barbara County, California. These were in company with *C. canescens* Mannerheim, *C. lithocharinus* LeConte, *C. luteipennis* Horn, *C. seminitens* Horn, *Aleochara arenaria* Casey, and *Hadrotes crassus* LeConte. They were generally taken beneath festoons of decomposing seaweed on and under a conglomerate of rock, beach pebbles, and sand. This locality is about 250 miles north of San Diego not far south of Point Conception, which is a barrier to many seashore insects (Moore and Legner, 1976).

It is of interest that on two occasions (Casey, Moore), this rare species was found in company with other species which are also known to be rare. This may indicate that, under those particular circumstances, special ecological conditions prevailed which enhanced their reproductive capacities. Usual ecological conditions in southern California may be marginal for them.

References Cited

Casey, T. L. 1885. New genera and species of Californian Coleoptera. Proc. California Acad. Sci. 1:284-336.

Horn, G. H. 1894. The Coleoptera of Baja California. Proc. California Acad. Sci., Ser. 2 4:302-449.

LeConte, J. L. 1863. New species of north American Coleoptera. Smith. Miscell. Coll. No. 167 p. 1-87.

Moore, Ian. 1937. A list of beetles of San Diego County, California. Oc. Pap. San Diego Soc. Nat. Hist. No. 2 p. 1-109.

Moore, Ian, and E. F. Legner. 1973. Speculation on the distribution of the southern California species of *Cafius* with a new record from the Salton Sea. Pan-Pac. Ent. 49:277-280.

Moore, Ian, and E. F. Legner. 1976. Staphylinidae. *In* Cheng: Marine Insects. North Holland Publ. Co., Amsterdam, p. 521-551.

* * *

BOOK REVIEW

The beetles of America, by Richard Headstrom. 1977. A. S. Barnes and Company, Inc., P. O. Box 421, Cranbury, N.J. 08512. Hardbound, 488p., $17.50.

Richard Headstrom took on quite an assignment when singlehanded he sat down to write, and illustrate, a guide to the beetles of America. This guide was prepared for the layman and may be useful also to high school biology teachers and to nature instructors. Twelve pages are devoted to the external morphology of beetles and the diagrams are clear and helpful. The diagram of the antenna is obviously patterned after the diagram in Comstock's *An Introduction to Entomology* and Headstrom uses the term *Clavola* (from Comstock) rather than the currently used term, *Flagellum.* The remainder of the Introduction includes material on food beetles eat, their eggs, hatching and development, molting, insect color, migration, and defense. The only key present is a dichotomous key to families which refers the reader to the page on which each families' general characteristics are discussed. For many of the families an outline diagram of a "typical" beetle is included. For each species presented, its scientific name, length, description, and distribution is given. A total of about 1200 species is included (this of course is but a fraction of the beetles found in the 48 contiguous states of the U.S.). Black and white diagrams of the elytra of about 500 species are depicted and about a dozen black and white photographs are included. The major shortcoming of this guide is that its title implies that the guide covers "the beetles of America" yet only a fraction of them are actually mentioned. The most meaningful way to cover this subject would be through a regional series of guides such as those planned by the Biological Research Institute of America, Inc. Such an approach to the identification of beetles in America is long overdue.

—Paul P. Shubeck

THE COLEOPTERISTS SOCIETY

Minutes of Annual Meeting

The 9th annual meeting of the Coleopterists Society was held August 24, 1976, at the Sheraton Hotel in Washington, D.C. The meeting was chaired by President Triplehorn who welcomed members and called the meeting to order. This meeting was held in conjunction with the XV International Congress of Entomology.

1. Because of the International Congress, several foreign coleopterists were present at the meeting, either as members or guests. These were introduced as follows: Besuchet, Switzerland; Galewski, Poland; Krikken, Netherlands; Menier, France; Peña, Chile; Reyes, Mexico; Sato, Japan; Wittmer, Switzerland.

2. Minutes of the 1975 meeting were accepted as published in the Bulletin, Vol. 30(1), 1976.

3. Secretary Gordon reported to the membership on business discussed at the executive committee meeting held earlier as follows. *Budget.*—The committee examined the budget and the rate at which the Society is publishing (about 400 pages per year) and it seems we are presently publishing at a rate that maintains our resources at a slightly increasing rate. *Review of papers submitted to the Bulletin.*—The question was raised as to whether all papers should be externally reviewed. No decision was reached. *Association of Systematic Collections.*—The question was raised whether or not to join; the cost of sending a representative to ASC meetings and the possibility of selecting a member located at the meeting site to represent the Society. It was resolved that the Society will support ASC at the rate of $25.00 annually with no money to be allocated for support of a Society representative. The president will appoint, if possible, a Society member in the city where the ASC meeting is held to represent the Society. This representative will submit a written report to the president, and a copy of this report will be given to any representative assigned to cover future ASC meetings. These reports will be published in the Newsletter. Brown motioned that the action of the executive committee be approved, seconded by Kavanaugh, discussion ensued, motion approved.

4. Officer's Reports.

   a. Secretary Gordon informed the membership that all proposed amendments to the constitution on the recently submitted ballot were approved by the membership.

   b. Treasurer Erwin submitted the appended report which was audited by D. M. Anderson, P. J. Spangler, and J. M. Kingsolver. Howden asked about billing procedures and Erwin explained them.

   c. Editor Whitehead. No official report.

5. Committee Reports.

   a. Nomination and elections committee. George Ball reported the election results. Bob Woodruff is our new President-Elect; new council members are Joe Schuh, Barry Valentine, and Charles O'Brien.

   b. John Kingsolver reported on the status of the Coleoptera Catalog as follows. Computer programs for production of the Catalog have now been completed. As soon as the cover design and a new map are finished, the Heteroceridae, Cupesidae, and Platypodidae can be published. Data for the Anobiidae have, for the most part, been entered. Cards for Ciidae, Languriidae, Cerylonidae, Rhysodidae, Pyrochroidae, Elmidae, Dryopidae, and Psephenidae have been received, while the Dermestidae and Colydiidae are nearly complete.

   c. Color standards committee. Howard Frank reported for the committee. The report is appended.

6. Arnett talked about his North American beetle fauna project. Biological Research Institute has given permission for manuals to be produced out of sequence. Donations are requested to reduce the sale price of each manual.

7. President Triplehorn appointed a new auditing committee consisting of Ted Spilman, Richard White, and Don Anderson.

8. President Triplehorn gave some closing remarks and installed the new president, Tommy Allen.

9. President Allen asked for new business; appointed a new nominating committee with Harley Brown as chairman, Brown to appoint two other members.

10. Newsletter. President Allen brought up the subject of the Newsletter and George Ball gave the results of the membership vote included with the election ballot. Choice e, "resume publication of the Newsletter as a separate entity from the Bulletin" received the most votes; choice c, "put the Newsletter at the end of the Bulletin with separate pagination" was next; choice b, "use the Newsletter as filler in the Bulletin without separation" was third. The remaining two alternatives did not receive enough votes to be considered further. Lengthy discussion ensued. O'Brien asked who would be editor; Allen asked O'Brien to do so and O'Brien consented but suggested that the editorship be rotated and solicited contribution of articles. Allen suggested O'Brien continue as editor for at least one year. O'Brien said that the Newsletter should not be restricted to a fixed number of issues per year. Woodruff pointed out that the additional cost of publishing the Newsletter should be considered particularly if the Newsletter were to be published separately. O'Brien agreed that the cost of separate publication was large, but pointed out the problems caused by requests from libraries when the Newsletter was included in the Bulletin. Woodruff moved that the executive committee take under advisement the vote on the Newsletter and the economics thereof. Lee Herman seconded the motion, discussion followed and Woodruff and Herman withdrew their motion. Howden moved that the Newsletter be incorporated in the Bulletin, with amount of content to be determined by the Bulletin editor and this content to be edited by the Newsletter editor. Motion was seconded by Ratcliffe and passed.

11. President Allen brought up the subject of the next annual meeting of the Society, discussion ensued. Herman moved that we continue to meet with ESA, other meetings not prohibited, motion seconded and approved. Informal discussion resulted in approval of some sort of meeting with ESA in Hawaii.

12. President Allen adjourned the meeting.

Respectfully submitted,

Robert Gordon
Secretary (1976)

* * *

LITERATURE NOTICE

Review of the pselaphid beetles of the West Indies (Coleoptera: Pselaphidae), by Orlando Park 1901-1969, John A. Wagner, and Milton W. Sanderson. Fieldiana: Zoology, Vol. 68, xi+90 p., Nov. 1976.

Begun by Park, this work happily was brought to completion by Wagner and Sanderson. The West Indian pselaphid fauna remains so poorly known that they regard this publication as a "review" rather than a "revision". Park had intended but had not started analyses of phylogeny and zoogeography, hence these are not included; however, there is a brief but useful discussion of the West Indies in relation to the pselaphid fauna.

—D. R. Whitehead

FINANCIAL STATEMENT NOVEMBER 26, 1975 TO NOVEMBER 27, 1976

(Audited by: D. M. Anderson, P. J. Spangler, J. M. Kingsolver)

Assets:	
Balance from 1975 (November 26)	$11,380.08
Income:	
Page charges, separates, postage on separates charged to authors	5,486.50
Membership dues, subscriptions	6,257.00
Back issues	42.00
Interest on savings and certificate at Northern Virginia Savings and Loan (Nov 26-Dec 31, 1975, all of 1976)	653.85
Donations for ESA/Coleopterists Hospitality night	106.00
Donations for XV Congress/Coleopterists Hospitality night	96.00
	$12,641.35
Balance of credits	$24,021.43
Disbursements:	
Printers cost of Bulletin Production (Dec 1975; March, June 1976)	$7,687.80
Addressograph service and envelopes	213.03
Inkblot Co. services and materials	201.05
Second class mailing permit/Editor's postage	381.44
ESA, 1975 Coleopterists Hospitality night	382.36
Service charges, Riggs Bank	22.93
Bounced checks	16.00
XV Congress, 1976 Coleopterists Hospitality night	160.15
Transpayment (Member to BRIA)	15.00
Postage (Secretary and Treasurer)	175.40
Balance of debits	$9,255.16
Income over disbursements (NOTE: This is high because only 3 Bulletin issues paid for in this statement)	$3,386.19
Total assets carried into 1977	$14,766.27

Respectfully submitted,

Terry L. Erwin
Treasurer (1976)

* * *

Color Standards Report

The Coleopterists Society Color Standards Committee, formed after the 1973 annual meeting of the society, was disbanded after the 1975 annual meeting. Its place has been taken by a Special Committee on Color Standards of the Entomological Society of America, which has 2 representatives of the Coleopterists Society: J. H. Frank and S. G. Wellso. The E.S.A. committee was formed by a decision of the President and Governing Board of the E.S.A. after presentation of a report on color standards by the Coleopterists Society Color Standards Committee. The reasons for forming an E.S.A. committee were: (1) that a good color standard used by coleopterists should also be of use to other entomologists, in fact to biologists in general, (2) that a single color standard instead of a diversity of standards should be used by all entomologists (biologists), (3) that a unilateral decision by coleopterists to adopt a color standard might not necessarily be followed by other entomologists (biologists), (4) that the requirements of other entomologists (biologists) should be investigated before the selection of a color standard, (5) that if it should prove necessary to design and publish a new color standard, the Coleopterists Society would not have the financial means to afford the publication costs.

The E.S.A. Special Committee on Color Standards, whose members were selected by the 1975-1976 E.S.A. President as representing all entomologists, has 2 coleopterists, 1 hymenopterist, 1 lepidopterist and 1 hemipterist. Essentially its purpose is identical to that of the former Coleopterists Society Color Standards Committee, namely: (1) to assess existing color standards, (2) to investigate the requirements of entomologists, (3) to define the format and means of production of a new color standard if no existing color standard should prove adequate. In addition to these tasks it is also seeking liaison with other biological societies and, at the 1976 annual meeting of the E.S.A. in Washington, a full collaboration was achieved with the Mycological Society of America Color Standards Committee, the requirements of the 2 committees having proven to be identical. This collaboration has given new impetus to both committees and at the present time the production and publication of a new color standard, for which the National Bureau of Standards is giving advice, seems to be probable within the near future.

Reports are to be found on p. 77-78 of the March 1976 (vol. 22) and p. 89 of the March 1977 (vol. 23) Bulletins of the E.S.A.

* * *

LITERATURE NOTICES

The myrmecophilous beetle genus *Echinocoleus* in the Southwestern United States (Leiodidae; Catopinae), by Stewart B. Peck. 1976. Psyche 83(1):51-62.

A review of the Mexican and Central American species of *Strangalia* Audinet-Serville (Coleoptera: Cerambycidae), by J. A. Chemsak and E. G. Linsley. 1976. Jour. N. Y. Ent. Society 84(4):216-232.

Rediscovery of *Bembidion rufotinctum* Chaudoir, with extreme range and distributional records of Bembidion and other Carabidae (Coleoptera), by Kenneth W. Cooper. 1976. Ent. News 87:159-166.

Observations on adult behavior of the lycid beetle *Calopteron terminale* (Coleoptera: Lycidae), by Horace R. Burke. 1976. Ent. News 87:229-232.

—Paul P. Shubeck

Notice to Authors

Manuscripts will be considered from any authors, although those from members of the Coleopterists Society are given priority. It is suggested that all prospective authors join the Society. All manuscripts should conform to instructions in the **Style Manual for Biological Journals** (3rd Ed.) prepared by the Committee on Form and Style of the Conference of Biological Editors, and published by the American Institute of Biological Sciences, 2000 P Street NW, Washington, DC 20063.

The following exceptions are noted: 1) all geographical names are to be spelled out, 2) use words, not symbols, for male and female, 3) use numerals throughout, except to begin a sentence, 4) entomology, -ical, -ist, etc. are to be abbreviated Ent. in literature citations.

Specimen label data should be listed in the following manner: MEXICO: State of Veracruz, Fortin de las Flores, 10-VIII-70, I. B. Jones, under bark of **Pinus moctezumae,** 7000ft. [USNM] (2). The number in parentheses indicates the number of specimens. Geographical names are listed in order with largest units first, with states, departments, provinces, parishes, and/or counties listed. Dates are listed by day, month (in Roman numerals), and last 2 digits of the year. Listing of ecological data is encouraged. Location of specimens should be shown in brackets; if the data are extensive these should be abbreviated as shown and the abbreviations listed in the text.

Any article concerning Coleoptera will be considered. Descriptions of new taxa must contain keys (or be correlated with existing keys) and illustrations. All manuscripts should be typed on 8½×11" opaque white paper with 1 inch margins. They should be typed on one side only and double spaced throughout (including title, footnotes, tables, figure legends, and references). All scientific names should be underlined. Use the following order: title, author, author's address, abstract, body of text, references cited, and figures. All footnotes, tables, and figure legends should be provided on separate sheets and double spaced. Indicate approximate figure and table locations in pencil in the margin of the manuscript.

An abstract is required for all articles longer than 2 manuscript pages. It should be a concise statement of the facts presented, not *that* they are presented (e.g., list actual conclusions derived from a discussion). This abstract is the key to how your article will be cited in abstracting journals and should be carefully written.

For the author's protection as well as for the editor's convenience, manuscripts should be submitted in duplicate. Manuscripts will be processed most rapidly if the authors have had them critically reviewed in advance; such critical reviews minimize the probability of rejection or major revision.

THE COLEOPTERISTS SOCIETY

Officers for the Society 1977

President: R. T. Allen, Dept. Ent., Univ. Arkansas, Fayetteville, AR 72701.

President-Elect: R. E. Woodruff, Florida Dept. Agr., P. O. Box 1269, Gainesville, FL 32601.

Secretary: R. D. Gordon, Syst. Ent. Lab., USDA, ARS, c/o U. S. National Museum, Washington, DC 20560.

Treasurer: T. L. Erwin, Div. Coleoptera, Dept. Ent., U. S. National Museum, Washington, DC 20560.

Editor (Coleopterists Bulletin): D. R. Whitehead, Syst. Ent. Lab., USDA, ARS, c/o U. S. National Museum, Washington, DC 20560.

Council through 1977: J. T. Doyen, H. S. Dybas, J. H. Frank.

Council through 1978: C. W. O'Brien, J. Schuh, B. D. Valentine.

NOTICES

Notices to appear on this page are a free service to members and subscribers. Such copy will be limited to the back page, the older notices being moved up and replaced with the newest ones at the bottom. The editor reserves the right to reword such notices for brevity, consistency, and clarity.

RHYSODIDAE: Wanted, for world-wide revision. Willing to identify and return or exchange for U. S. Carabidae. Ross T. Bell, Zoology Dept., University of Vermont, Burlington, VT 05401, U.S.A.

SCARABAEIDAE: Working toward a general revision of the Anomalinae of Mexico, Central, and South America. Specimens and records needed by loan, purchase, or exchange. Identifications by arrangement. Robert W. L. Potts, California Acad. Sci., Golden Gate Park, San Francisco, CA 94118.

CHRYSOMELIDAE (ALTICINAE): Reworking manuscript revision of the maculate species of *Phyllotreta* of the U. S. and Canada for publication (includes the normally immaculate *P. denticornis, P. decipiens,* and *P. d. ordinata*). Request loan of such material immediately. Eric H. Smith, Division of Insects, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

MELOIDAE: Revising the genus *Gnathium* (Nemognathinae). Request loan of specimens from all areas, Mexican material being particularly welcome. Wilbur R. Enns, 1-87 Agriculture Building, University of Mo., Columbia, MO 65201.

DETERMINATIONS DESIRED: Blacklight trap operated year-round in Puerto Rico. Advise your interest, and if it appears I will send it to you in 70% alcohol in return for mounting and ID. You keep duplicates. H. L. Murphy, Calle 21 Sur # 0-1, Bayamon Gardens, Bayamon, PR 00620.

SCARABAEIDAE: For sale or trade—specimens of *Goliathus cacicus, G. regius,* and occasionally *G. atlas* and *G. albosignatus*; wanted—other African Cetoniinae and Lucanidae. Write for prices and specific desiderata. Chris Adamson, 2437 Warring # G, Berkeley, CA 94704.

PEDILIDAE: Revising North American species of *Pedilus*. Request loan of determined and/or undetermined larvae and adults from any area. Also interested in bionomics of group, correspondence welcome. Daniel K. Young, Dept. Ent., Michigan State Univ., East Lansing, MI 48824.

CICINDELINAE CATALOGUE WANTED: Coleopterorum Catalogus # 86, W. Horn, 1926. H. Boyd, Oak Shade Rd., Tabernacle Twp., RD 4, Vincentown, NJ 08088.

CERAMBYCIDAE: Need *Derancistrus* spp. from all areas for study. Will buy or exchange. Julio Micheli, 14 Baldorioty Str., Mariani, Ponce, PR 00731.

AVAILABLE FREE: Werner, Enns, Parker, "The Meloidae of Arizona", TB 175 (1966) and Butler & Werner, "Distrib. and Host Plants of May Beetles in Arizona", TB 147 (1961). Floyd G. Werner, Dept. Ent., Univ. Arizona, Tucson, AZ 85721.

FOR SALE: First class well preserved colorful insects and butterflies, many hundreds of species and subspecies. Small or big order accepted; will send by air mail to your home. Peter Andersen, Global Colosseum, 67 Spottiswoode Park Rd., Spore 2, SINGAPORE.

EXCHANGE: Wanted—North and Central American Dytiscidae, Gyrinidae, Dryopidae, Elmidae, Heteroceridae, Haliplidae. Offered—species from Central Europe. Witold Wiezlak, 04-607 Warszawa, Trawiasta 29 b, POLAND.

FOR SALE: Melolonthinae—very rare *Euchirus dupontianus* at $150/pair, postpaid airmail. Assorted Asian Coleoptera-$100/box. Mrs. Zenaida Jardiniano, Nepomuceno Street, Boac, Marinduque 3801, PHILIPPINES.

PSEPHENIDAE (PSEPHENINAE, EUBRIINAE, EUBRIANACINAE, PSEPHENOIDINAE): Revising for world. Request loan of specimens from all areas. Harley P. Brown, Zoology Dept., Univ. Oklahoma, Norman, OK 73019.

HYDROPHILIDAE WANTED: Preserved in isopropyl-carnoy (3:1 isopropyl to glacial acetic acid) for chromosome analysis. Will exchange other families similarly preserved. Stan Malcolm, Box U-43, Biol. Sci. Grp., Univ. of Connecticut, Storrs, CT 06268.

CERAMBYCIDAE: Buy, exchange all species from neotropical region, especially from Central America, ask for list. Dr. K.-E. Hüdepohl, Brunnenhof, D-8134 Aschering, West Germany.

WANTED: Carabus, Calosoma, Cychrus, Scarabaeidae, Cerambycidae in exchange for same or other families from Austria, Belgium, France, Germany, Italy. Maurizio di Leo, Via Corsica #1, 40135 Bologna, Italy.

TENEBRIONIDAE: Wanted—literature from South America, for purchase or in exchange for named specimens; wanted—specimens from Patagonia, Andes Range, and arid areas of South America for study. Luis E. Pena G., P.O. Box 2974, Santiago, Chile.

FOR SALE: 5m × 2.5 m linear MALAISE TRAPS. Collecting heads utilize cyanide ı/or alcohol. Proven design used world wide. Additional information & prices write D. A. Focks, P. O. Box 12852, Gainesville, FL 32604.

FOR SALE: We have many new colourful butterflies from Burma, Thailand, Indonesia, and Sumatra, as well as from Malaysia. Good quality assured. Reasonable prices. Small/big orders welcome. Will send by air mail to your home. The Global Colosseum, Tanjong Pagar P. O. Box 11, Tanjong Pagar, Spore 2, Singapore.

FOR SALE: R. C. L. Perkins, David Sharp, & others, Fauna Hawaiiensis, 1910, Vol. I-III complete, bound, excellent condition, with many original descriptions, $400. E. J. Ford, Jr., 103 South Gay Street, Room 517, Baltimore, MD 21202.

WANTED: Coleopterorum Catalogus #71 A. Zimmermann, #79 A. Knisch; On aquatic carnivorous Coleoptera or Dytiscidae by D. Sharp; British water beetles vols. I, II by F. Balfour-Browne. Sh. Hosseinie, Dept. Biol., College of Arts & Sciences, Pahlavi University, Shiraz, IRAN.

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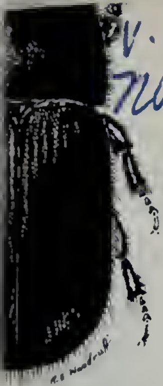

THE COLEOPTERISTS BULLETIN

AN INTERNATIONAL JOURNAL DEVOTED TO THE STUDY OF BEETLES

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Edited By: Donald R. Whitehead
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THE COLEOPTERISTS BULLETIN

(FOUNDED 1947 BY ROSS H. ARNETT, JR.)

The **Coleopterists Bulletin** is published quarterly, beginning in March, by the Coleopterists Society. Send all manuscript articles, editorial questions, subscription inquiries, and address changes to the *Bulletin editor*: Dr. Donald R. Whitehead, c/o Dept. Entomology, Stop 168, Smithsonian Institution, Washington, DC 20560. Send requests for missing issues to the *managing editor*: Dr. Robert E. Woodruff, Florida Dept. Agr., P. O. Box 1269, Gainesville, FL 32601. Send material for literature review to the *review editor*: Dr. Paul P. Shubeck, Dept. Biology, Montclair State College, Upper Montclair, NJ 07043. *Associate editor*: Dr. Robert D. Gordon, Syst. Ent. Lab., USDA, ARS, c/o U.S. National Museum, Washington, DC 20560.

Starting in 1977, a revived **Coleopterists Newsletter** appears in the Bulletin when warranted by sufficient material. Send all news items, collecting notes, and similar material to the *Newsletter editor*: Dr. Charles W. O'Brien, Lab. of Aquatic Ent., Univ. P. O. Box 111, Florida A&M Univ., Tallahassee, FL 32307.

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Vol. 4-20 Catholic University Press, Washington, DC 20017.
Vol. 21-24 Dept. Entomology, Purdue Univ., Lafayette, IN 47907.

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Separates: All except very short articles are arranged to begin on a right hand page. A maximum of 200 separates (*not* reprints) can be supplied from additional copies of the issue and cannot be supplied with covers nor free of extraneous matter. Separates may be ordered in units of 100 or 200, and they must be ordered in advance on an order form supplied with galley proof.

Charges for Separates: These will be specified on order form. Charges are computed @ $9.00 per 100 separates for articles up to 2 pages in length, plus $4.00 per 100 for each additional 2 pages or fractions thereof.

(*Continued inside back cover*)

(Mailed under second-class permit at Gainesville, Florida. Postmaster: send form 3579 to editorial office—Dr. D. R. Whitehead, c/o Department of Entomology, Stop 168, Smithsonian Institution, Washington, DC 20560).

SOME BEETLES IN PLINY'S *NATURAL HISTORY*

John Scarborough

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Abstract

Pliny the Elder (A.D. 23-79) is famous for his wide-ranging *Natural History.* Included among the fauna are 14 species of Coleoptera. Especially interesting are 3 species in the subfamily Lyttinae.

Introduction

One of the most interesting ancient Roman authors, whose works have survived to be savored by modern readers, is Pliny the Elder (A.D. 23-79). Not only was he prominent as a political and military leader, but he was also one of the outstanding polymaths of his time. His enthusiasm and curiosity seems to have been unlimited, and he met his death in 79 from suffocation when he got too close to the erupting Vesuvius, while commanding a fleet of ships dispatched to help refugees fleeing from Pompeii and Herculaneum. Although many of his writings on history, as well as those on the Roman military campaigns in Germany, have not survived, Pliny's monstrous collection of varia—the *Natural History*—has come down to us almost intact. Within the 37 books is an incredible hodgepodge of facts, theories, myths, tales-told-for-amusement, and gleanings from earlier Greek works. The *Natural History* became a storehouse of semi-believable and believable tales for medieval storytellers, and Pliny's anecdotes of the headless tribesmen of India, seadragons of the farthest oceans, and misty lands far beyond Ultima Thule, were stock items in common knowledge when Columbus sailed west in 1492.

Pliny's booklearning is beyond dispute. He tells us that his work contains 20,000 "facts" borrowed from 2,000 learned works, and the scope of his curiosity covers literally everything. First comes astrology and astronomy, then a detailed description of the earth's surface (which may be purloined from Pomponius Mela, or Marcus Agrippa, earlier authors of geographies). Next comes a description of man, a collection of historical anecdotes ranging from the philosophical speculations of Pompey the Great (104-48 B.C.) to the fact that only one woman in history (the Spartan lady, Lampido) was daughter, wife, and mother of a king. Further sections of the *Natural History* have the label "zoological." Man is employed as the occasional contrast with all other animals, and Pliny lards everything with as many tales as he can squeeze into his breathless account.

Pliny's Coleoptera

Among the hundreds of different animals Pliny describes, there are 14 species of Coleoptera that can be keyed with fair assurance. It is of great interest to historians of entomology to contrast Roman (and Greek) taxonomic methods with those of modern times. Nomenclature of insects was always based either on characteristics of observed habits, or on the effects on man, either beneficial or destructive. There is little evidence that Greeks and Romans did more than Aristotle had suggested: classify by "type," which was meant in the broadest sense of comparative anatomy. Animals that were warm-blooded and gave birth to their young alive could be distinguished from other "types," but the comparison was always to man. This ladder-notion remains with us today, when we speak of the primates as the "highest" order.

The 14 species in the *Natural History* are: *Drilus flavescens* Fabr. (*Natural History,* XI, 98, and XVIII, 250), *Scarites laevigatus* F. (XXX, 39), *Meloe variegatus* L. (XXII, 30, and XXX, 30), *Ergates faber* L. (XI, 113; XIII, 134; XVII, 220; and XXX, 115), *Polyphylla fullo* L. (XXX, 100), *Sitophilus granarius* L. (XVIII, 302), *Ateuchus sacer* L. (XI, 70 and 97; XX, 98; and XXX, 99), *Lucanus serraticornis* Fairm. (XI, 97), *Lampyris splendidula* L. (XI, 98), *Anobium pertinax* L. (XI, 98), *Cetonia speciosissima* Scop. (XXIX, 32), and 3 cantharid species of the subfamily Lyttinae. Pliny relates most of his information about many of his insects and beetles (*e.g.* fireflies, stagbeetles, dung beetles and the "sacred scarab" of Egypt) through folktales and by citing other authorities. His accounts illuminate the way Romans (and their Greek predecessors) studied insects, and also explain why they studied them at all. Of course, some insects such as bees (which form the main subject of Vergil's *Georgics,* Book III) had venerated economic utility, but most insects received attention only if they were associated either with folkmedicine or traditions based on hoary and accepted superstitions. Pliny's blister beetles illustrate both.

LYTTINAE IN THE *Natural History*

The 3 species of blister beetles in the *Natural History* probably are: *Lytta dives* Brullé (*Natural History,* XXIX, 76, 93, and 94), *Lytta segetum* Fabr. (XXVIII, 78), and *Lytta nuticollis* Muls. (XXIX, 94). These 3 kinds of beetles were known to have the substance called *cantharis,* which was also the name commonly given to the beetles. In modern pharmacy, the substance is cantharidin, and it remains useful in veterinary medicine (except for dogs and cats) as a vesicant and counterirritant in diseases of bones, joints, ligaments, tendons, and bursae. In classical antiquity, *cantharis* had many reputable uses, including being the main ingredient in "love potions," the dim ancestors of the notorious "Spanish Fly." Pliny recognizes *cantharis* as medically harmful and beneficial, and tells (XXIX, 93-94) how it is a much argued question in his day just where the substance was in the insect: "some believe the feet and the head, but everyone agrees that the wings are important." *Pinnae* here may mean elytra, but most likely Pliny does not distinguish between the elytra and the wings, understandable when one sees the outstretched elytra of a blister beetle in flight.

Pliny writes that *cantharis* in a drink was poisonous and caused very sharp pains in the bladder. A certain Cossinus (Pliny adds by way of illustration), friend of the Emperor Nero (A.D. 54-68), had died when an Egyptian doctor gave Cossinus a drink of *cantharis* for treatment of *lichen* (probably ringworm). He goes on to say that *cantharis* mixed with grape juice, and sheep or goat suet is very helpful against skin diseases, applied externally. But Pliny confuses the *cantharis* with the gall made by a gall wasp (the British "Robin's Pin Cushion"), which suggests a confused recipe tradition for the salve.

There are crabbed instructions for the preparation of the salve. One puts the beetles into an earthen pot, not lined with pitch (as the normal wine jug would be), closes the mouth with a piece of cloth, and hangs it (presumably upside down) over boiling vinegar and salt. The steam suffocates the beetles, and then they are put away in storage. The prepared *cantharides* were very valuable, and Pliny tells the story of Cato the Younger (95-46 B.C.) being brought to trial for auctioning off a king's royal store of the drug for 60,000 sesterces. *Cantharis* was also thought to be most beneficial after the touch of a salamander, believed to be very poisonous (XXIX, 76).

Cantharis beetles were sometimes so numerous that swarms of them devastated crops, especially in Asia Minor. Pliny notes that there is only one real measure that is effective against such invasions: have a menstruating woman walk through the fields, and ". . . caterpillars, worms, beetles, and other vermin will fall to the ground" (XVIII, 77-78). This discovery was made in Cappadocia (Pliny's authority here is Metrodorus of Scepsis [*fl. c.* 140 B.C.]), when a plague of cantharid beetles was banished by a menstruating woman walking through the fields. To Pliny, this illustrates the "incredible power of women," especially when they menstruate, a folk tradition linked with magic and witchcraft in many early cultures.

Pliny's blister beetles may also include the very common *Cantharis vesicatoria* L., and the same conclusions could be drawn from his account of this species as from his accounts of the others. It seems certain that the reputation of *C. vesicatoria* was well established in classical antiquity, since Pliny is not the only author to give attention to *cantharis* in the magical and medical traditions. Galen of Pergamon (*c.* A.D. 129-199), the famous physician, believes the beetle worthy of extensive comment particularly in the preparation of antidotes against its well known effects (esp. in *Faculties and Blendings of Simple Drugs,* Bks. VII-XI, and *Compounding Drugs According to Parts of the Body,* Bks. I-VI [ed. C. G. Kühn, Vol. XII]). Celsus (*fl.* in the reign of Tiberius [A.D. 14-37]), and Dioscorides (*fl. c.* A.D. 50-70) are among the many other Greek and Roman authors on medicine and drugs that consider blister beetles important in the medical practice of the time.

The modern cantharidin is prepared from dried specimens of *C. vesicatoria,* and the elytra alone are used in modern pharmacy, since they contain more of the active principle (cantharidin: hexahydro-3a,7a-dimethyl-4,7-epoxyisobenzofuran-1,3-dione; the preparation, derived from the elytra usually contains 0.6-1% cantharidin, 10-15% fat, resinous matter, and acetic and uric acids) than all of the other body parts combined. Imms (1970) reports that Beauregard (1890) found the third pair of accessory glands in the male *C. vesicatoria* was extremely rich in cantharidin, but commercial preparation of the drug depends almost exclusively upon the elytra. Pliny (*Natural History,* XXIX, 93-94) was quite correct in his learned guess concerning the source of *cantharis.*

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TERTIARY COLEOPTERA FOSSILS FROM THE NORTH AMERICAN ARCTIC

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Abstract

Studies of fossil Pleistocene beetles in the Arctic indicate little evolution or extinction during the last million years. A few Arctic localities have yielded fine Tertiary beetle fossils, of late Miocene age. These older materials are of great evolutionary significance, as many apparently extinct species are included. Proper analyses of the fossil forms depend on an understanding of relationships among extant forms. Taxonomic revisions are therefore at their most useful when phylogenetic constructs have been included, ready for testing and refinement.

Introduction

Most coleopterists are well aware of the burgeoning role of Coleoptera fossils in Pleistocene paleoecological studies (Coope 1970, 1975). In those areas of the world where the existing coleopterous fauna is well documented, beetle fossils may be more sensitive indices of climatic change than even such traditional types of evidence as fossil pollen or plant macrofossils (Coope and Brophy 1972; Osborne 1974; Coope 1975). Although fossils of Pleistocene beetles have been of interest to various workers for many years, it is only in the last 30 years that their value for paleoenvironmental studies has been realized. The centre of such research has been England, where since the late 1950's G. R. Coope and his associates have carried out numerous detailed studies. More recently, similar investigations have been initiated in other parts of Europe (Panfilov 1965; Ullrich 1972; Kopenen and Nuorteva 1973; Angus 1975) and Siberia (Kiselev 1973; Matthews 1974a). North American paleoecological studies using fossil Coleoptera have lagged behind those of western Europe, but several recent papers (Coope 1968; Matthews 1968, 1974b, 1975; Ashworth 1975; Ashworth and Brophy 1972; Ashworth *et al.* 1972; Morgan 1972, 1975) show that the approach is quickly gaining acceptance on this continent.

An outstanding finding common to all of these studies is that the evolution of the Coleoptera has been very slow. The majority of fossils that preserve definitive structural characters can be matched with comparable elements of extant species, this being so even for fossils as old as the early Pleistocene (Matthews 1974b). Occasionally, well preserved Pleistocene fossils seem to have no living counterpart, suggesting that they refer to extinct species; however, these have usually proved, on further study, to be contemporary residents of sites far removed from the fossil locality (Coope 1974; Ullrich and Coope 1974) or, as in the case of the weevil *Vitavitus thulius* (Kissinger 1973), undescribed members of the existing local fauna (Matthews 1974b). Thus for those taxa that are represented by fossils, there seems to have been little evolution or extinction for approximately the last one million years. If fossils of extinct species with a bearing on evolutionary history are to be found, they will likely occur in Tertiary rather than Pleistocene sediments.

Unfortunately many Tertiary beetle fossils are preserved as casts or impressions that even under the best conditions are usually inadequate for more than tentative assessment of generic and specific affinities (e.g., see figures in Gersdorf 1969, 1971; Larsson 1975; Smiley *et al.* 1975). Recently, however, well preserved Tertiary fossils have been discovered at sites in western Alaska and the Canadian Arctic (Hopkins *et al.* 1971; Matthews 1974c, 1976a). Like the Coleoptera fossils of Pleistocene age, these Tertiary fossils consist primarily of disarticulated fragments (heads, pronota, elytra, etc.), which may be readily compared with corresponding parts of recent beetle specimens.

Since many of these newly discovered Tertiary beetles seem to represent extinct species, they have much more evolutionary significance than do the Pleistocene fossils. One purpose of this report is to make coleopterists aware of the information at hand, most of which has been discussed previously only in non-entomological journals. In addition, this paper also registers a plea for coleopterists to recognize the special problems associated with study of such fossils and to be aware of the information which they, as taxonomists, possess that might greatly aid in the interpretation of the fossils.

Fossil Localities and Age

Table 1 is a list of the Tertiary fossils discovered as of March, 1976. Although the list includes only Coleoptera, the fossil assemblages also contain fragments of Diptera, Hymenoptera (especially Ichneumonoidea and Formicidae), Homoptera (Cicadellidae), oribatid mites, and fragments of Crustacea (Notostraca and Cladocera).

All of the fossils listed in the table come from 3 localities, 1 being the Lava Camp site in western Alaska (Hopkins *et al.* 1971) and the other 2 (Meighen Island and Banks Island—see Table 1) representing widely separated exposures of the Beaufort Formation in the Canadian Arctic Archipelago (Fig. 1) (Matthews 1974c, 1976a). Specifically, Banks Island fossils originate in autochthonous and detrital peats within the upper member of the Beaufort Formation at Ballast Brook on the northwestern side of the island. The Meighen Island specimens were found in peats at several stratigraphic levels in Beaufort Formation exposures on the west side of the island. The best preserved Coleoptera fossils discovered to date come from Meighen Island; however those from Lava Camp are perhaps more significant because their age is better known.

The reason for this is that all of the fossils from Lava Camp were contained in organic sediments immediately underlying a dated basalt. Wood and peat within these sandy sediments are charred, indicating that they (and the insects associated with them) represent a forest environment of about the same age as the time of the extrusion of the lava flow, which is known from Potassium Argon analyses to have occurred approximately 5.7 million years ago (Hopkins *et al.* 1971). Originally the Lava Camp site was assigned to the Pliocene, but now that the beginning of the Pliocene is placed at 5 million years, Lava Camp beetle fossils must be referred to the late Miocene.

The age of the Beaufort Formation fossils is less certainly known. Comparison of fossil plant assemblages from Beaufort sites with those described in southern Alaska (Wolfe *et al.* 1966) suggests that all Beaufort sediments seen to date are at least of Miocene age (Hills *et al.* 1974; Hills and Bustin 1976). Many of the plant and insect fossils are undoubtedly older, possibly greater than 8 million years (Matthews 1976a)—that being the age of the boundary of the Homerian and Clamgulchian time stratigraphic units as defined in Alaska (Wolfe *et al.* 1966; Triplehorn *et al.* 1977).

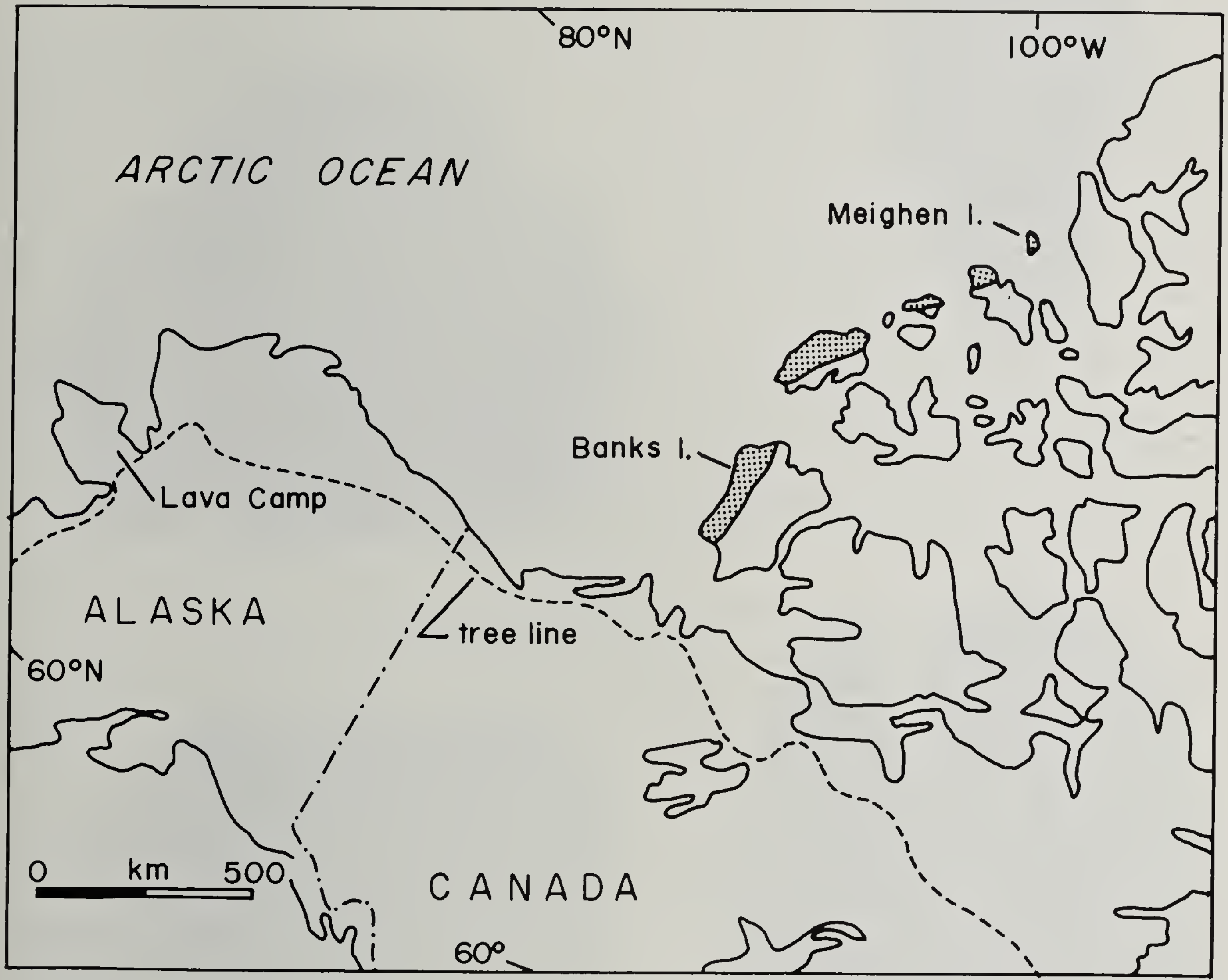

Fig. 1: Sites mentioned in the text. Stippled area of the Arctic Archipelago is the approximate extent of the Beaufort Formation.

Fossil Preservation

Despite their great age, the fossils listed in Table 1 are exceptionally well preserved (Fig. 2). A few are partially articulated and contain fragments of wings and genitalia. The majority, however, represent fragments of beetles, mostly pronota, heads, and elytra. The fragments are neither severely crushed nor distorted and display no visible evidence of chemical alteration. Though not as well preserved as amber specimens (Bachofen-Echt 1974), they are more numerous and represent a wide range of biotopes. Many of them possess remnants of the original vestiture, punctation, microsculpture, and colour. One constant difference between the fossils and modern specimens is that the former are always darker (Kiselev 1973),

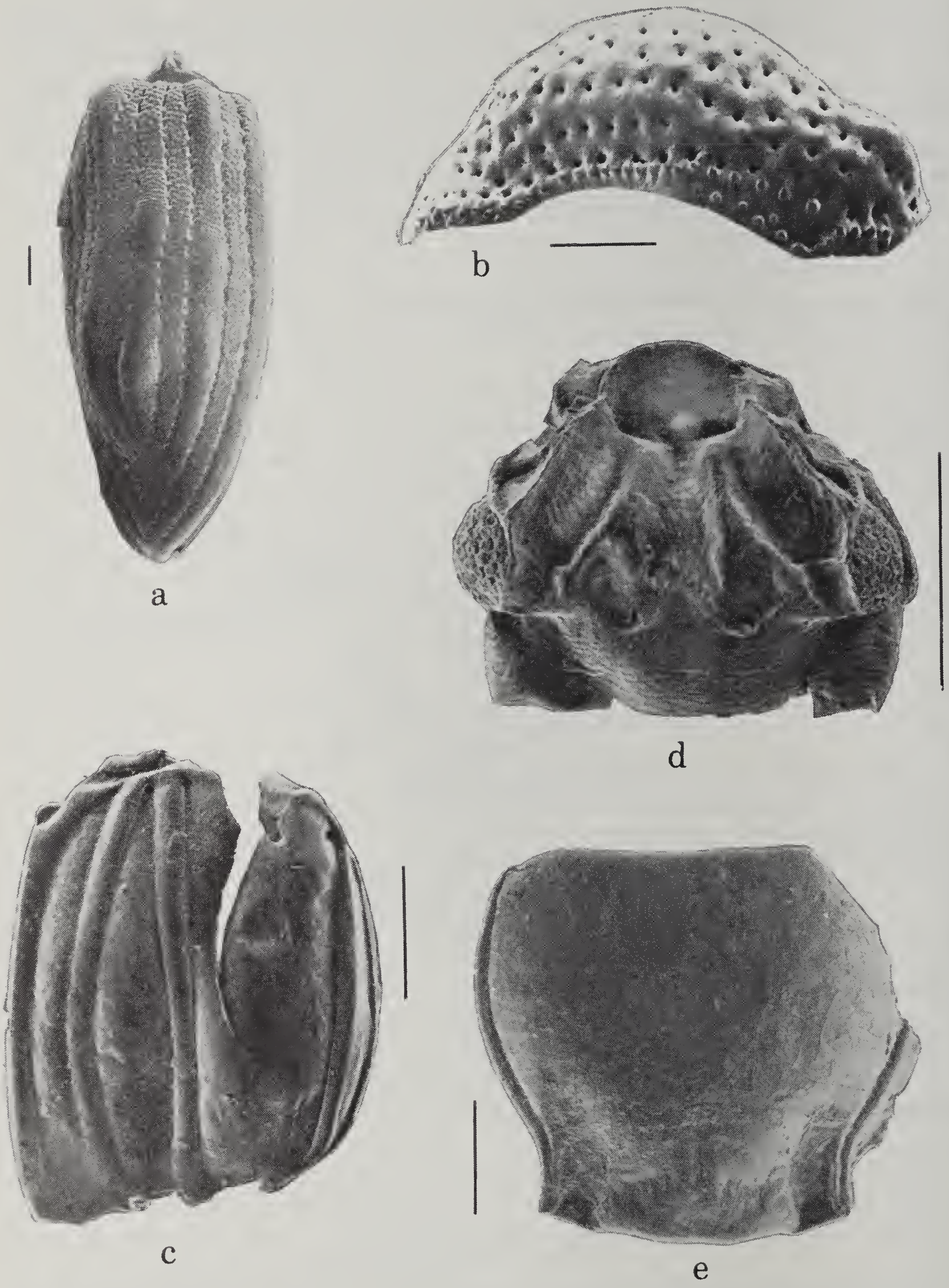

Fig. 2: a) *Grypidius* cf. *G. equiseti* Fab. (Curculionidae); lft. elytron; GSC-48727; Meighen Island, sample JVM 5-73; b) *Georyssus* sp. (Georyssidae); lateral view of rt. elytron; Lava Camp, Alaska; same specimen illustrated by line drawing in Fig. 7a of Hopkins *et al.* 1971; c) *Kalissus* cf. *K. nitidus* Lec. (Staphylinidae: Micropeplinae); rt. elytron; Lava Camp, Alaska; same specimen identified as *Kalissus nitidus* and illustrated in Fig. 2 of Hopkins *et. al.* 1971; d) *Micropeplus sculptus* Lec. (Staphylinidae: Micropeplinae); head (slightly distorted); GSC-48728; Banks Island, sample JVM 3-73; e) *Bembidion (Trepanedoris)* cf. *B. psuedocautum* Lth. (Carabidae); pronotum; Kugruk River, Alaska, Loc. 1226, near Lava Camp. Scale bar = 0.25 mm.

which means that the colour pattern of species with maculate elytra is usually somewhat obscured. A few of the carabid fossils also possess anomalous punctures on the elytra or pronota, but these features are clearly postmortal in origin and have been observed as well on Pleistocene specimens (Lindroth 1948). Figure 2 is intended to show the excellent preservation of the fossils by illustrating specimens from several different families.

Identification Notes

Several features of Table 1 require explanation. Note for example the uneven precision of identifications. Some fossils are identified only to the familial level; many are referred to genera; while a considerable number of the carabid specimens and a few in other families are compared with ("cf") existing species. In large measure this variation of resolution is related to the lack of diagnostic features on some fossils (despite their excellent preservation) and to the fact that a number of the fossils refer to groups which are today poorly known taxonomically. As an example of the first situation note that two important Coleoptera groups, Cerambicidae and Cicindelidae, are identified only to familial level, the reason being that mandibles of adults were the only fossils available. On the other hand well preserved, diagnostic specimens relating to the Omaline staphylinids, Ptiliidae, Byrrhidae, Colydiidae (*Namunaria*) are available, but cannot be compared with existing species because portions of those groups require taxonomic revision.

In contrast, the Carabid fauna of Canada and Alaska is well documented. Accordingly not only is it possible to relate carabid fossils to existing genera (all of them occurring in Alaska and Canada today) but in a number of instances the extant species which the fossils most resemble are also named. The similarity of fossils to modern specimens is remarkable (cf. *Diacheila* fossil in Matthews 1976a); nevertheless preliminary studies indicate that most of them will ultimately be found to refer to undescribed, extinct species. A few have already been described and treated as such (Matthews 1970, 1976b) while others are currently under study. It is worth noting, however, that the age of these late Tertiary assemblages is not beyond the range of all existing species since both the Lava Camp and Meighen Island assemblages also contain fossils of species (e.g., *Micropeplus tesserula*) which are extant.

Discussion

Current research on Tertiary Coleoptera fossils from northern North America is centered on several exposures of the Beaufort Formation, particularly the ones on Meighen Island in the Canadian High Arctic. But samples from the Alaskan Lava Camp site are still under study; a site near Lava Camp has yielded a small assemblage of Tertiary fossils (see Fig. 2e and Matthews 1977); and there is hope that sediments beneath a 5 million year old volcanic ash in interior Alaska will also yield well preserved beetle fragments. Such fossils are important for evolutionary studies, but they may serve another purpose—correlation and dating, a use to which fossil insects have seldom been put (Matthews 1976b).

Table 1. Fossil Coleoptera from late Tertiary Sites in Arctic North America.

Taxon	Lava Camp	Meighen Island	Banks Island
Cicindellidae			
Genus?		x	
Carabidae			
Trachypachus cf. *T. holmbergi* Mann.		x	
Trachypachus sp. A.	x	x	
Trachypachus sp.			x
Carabus cf. *C. truncaticollis* Eschz.	x		
C. cf. *C. vietinghoffi* Adams		x	
C. cf. *C. chamissonis* Fisch.		x	
Carabus sp. A.		x	
Leistus sp.	x		
Pelophila cf. *P. borealis* Payk.		x	
Nebria cf. *N. nivalis* Sahlb.[1]	x		
Nebria cf. *gyllenhali* sp. grp.		x	
Opisthius cf. *O. richardsoni* Kirby		x	
Notiophilus cf. *N. aeneus* Herbst	x		x?
N. cf. *N. directus* Casey		x	
Notiophilus sp.			x
Diacheila cf. *D. polita* Fald.		x	
cf. *Diacheila*			x
Blethisa cf. *B. multipunctata* L.		x	
B. cf. *B. catenaria* Brown		x	
Elaphrus cf. *E. lapponicus* Gyll.		x	
E. cf. *E. clairvillei* Kirby[2]		x	
E. riparius complex[2]		x	
Elaphrus americanus complex[2]		x	
Elaphrus sp.			x
Dyschirius cf. *D. laevifasciatus* Horn		x	x
D. (Dyschiridius) sp.	x		
D. cf. *D. globulosus* say	x	x	
Patrobus cf. *P. septentrionis* Dej.	x	x	
Patrobus sp.			x
Platidiolus cf. *P. vandykei* Kurn.		x	
Trechus sp.	x		
Asaphidion alaskanum Wick		x	x
Bembidion cf. *B. lapponicum* Zett.		x	
B. (Chrysobracteon) sp.			x?
B. cf. *B. nitidum* Kirby			x
B. cf. *B. dyschirinum* Lec.		x	
B. (Plataphodes) spp.	x	x	x
B. cf. *B. planatum* Lec.		x	
B. cf. *B. bimaculatum* Kirby		x	
B. cf. *B. nigripes* Kirby		x	
B. cf. *B. acutifrons*	x		

Table 1 (Cont.).

B. cf. *fortestriatum* Motsch.		x	
B. (Trepanedoris) sp.	x		
Bembidion spp.	x	x	x
Tachyta cf. *T. angulata* Casey[3]			x
Pterostichus cf. *P. corvinus* Dej.	x		
P. cf. *P. circulosus* Lth.		x	
P. (Derus) sp.		x?	
P. (Cryobius) cf. *P. kotzebuei* Ball		x	
P. (Cryobius) cf. *P. tareumiut* Ball		x	
P. (Cryobius) ventricosus sp. grp.		x	
P. (Cryobius) brevicornis sp. grp.		x	
P. (Cryobius) cf. *P. nivalis* Sahlb.	x		
P. (Cryobius) spp.	x?	x	x?
P. cf. *P. vermiculosus* Men.	x	x	
P. cf. *P. haematopus* Dej.		x	
Agonum cf. *A. consimile* Gyll.		x	
A. cf. *A. bicolor* Dej.		x	
A. cf. *A. cincticolle* Say		x	
Agonum sp.	x		x
Amara cf. *A. alpina* Payk.		x	
A. cf. *A. carinata* Lec.		x	
Amara sp.	x		
Harpalus cf. *H. amputatus* Say		x	
H. cf. *H. cordifer* Notman		x	
Dromius cf. *D. ruficollis* Motsch.	x		
D. cf. *D. piceus* Dej.		x	
Chlaenius sp.		x	
DYTISCIDAE			
Hydroporus sp.		x	
Agabus sp.		x	
Ilybius sp.		x	
Colymbetes sp.		x	
GYRINIDAE			
Gyrinus sp.		x	x
HYDROPHILIDAE			
Helophorus sp.		x	
H. (Cyphelophorus) coopei Matth.*	x		
H. (Cyphelophorus) meighenensis Matth.*		x	
Hydrobius sp.		x	
GEORYSSIDAE			
Georyssus sp.	x	x	
STAPHYLINIDAE			
Kalissus cf. *K. nitidus* Lec.	x		
Kalissus sp. A.		x	
Micropeplus tesserula Curtis	x		
M. hopkinsi Matth.*	x		
M. hoogendorni Matth.*	x		
M. sculptus Lec.		x	x
Carpelimus sp.[1]		x	

Table 1 (Cont.).

Bledius sp.		x	
Syntomium sp.	x		
Arpedium sp.	x?	x	
Acidota sp.		x	
Pycnoglypta cf. *P. lurida* Gyll.		x	
Olophrum sp.		x	
Omalium sp.		x	
Micralymma cf. *M. brevilingue* Schiødt		x	
Genus (Coryphiini?)	x		
Stenus spp.	x	x	x
Quedium (Raphirus) aenescens sp. grp.		x	
Tachinus cf. *T. jacuticus* Popp.		x	
Tachinus sp.			x
Tachyporus sp.		x	
Gymnusa sp.		x	x
Lathrobium sp.	x		
PSELAPHIDAE			
Genus?			x
SILPHIDAE			
Silpha cf. *S. ramosa* Say		x	
Phosphuga cf. *P. atrata* L.		x	
LEPTODIRIDAE			
Colon sp.			x?
LEIODIDAE			
Genus?	x	x	
PTILIIDAE			
Acrotrichis sp.	x		
Micridium sp.[5]	x		
SCYDMAENIDAE			
Genus?	x	x	
HISTERIDAE			
Platysoma (Cylister) sp.[6]		x	
SCARABAEIDAE			
Aegialia sp.		x	
BYRRHIDAE			
Simplocaria sp.	x	x	
Byrrhus sp.	x	x	
Cytilus sp.		x	
Morychus sp.		x	
Curimopsis sp.		x	
Eusomalia?			x
ELATERIDAE			
Hypolithus cf. *H. sandborni* (Horn)[7]		x	
ANOBIIDAE			
Genus	x		
TENEBRIONIDAE			
Iphthimus?	x		
ANTHICIDAE			
Genus?	x	x	

Table 1 (Cont.).

COCCINELLIDAE			
Genus?		x	
LATHRIDIIDAE			
Enicmus sp.	x		
Stephostethus sp.		x	
Genus?	x	x	x
COLYDIIDAE			
Namunaria sp.	x		
Bitoma sp.		x?	
CERAMBYCIDAE			
Genus?	x		
CHRYSOMELIDAE			
Donacia sp.		x	
Chrysolina sp.	x		
CURCULIONIDAE			
Apion sp.		x	
Vitavitus thulius Kissinger[8]	x		
Vitavitus cf. *V. thulius* Kissinger		x	
cf. *Lepidophorus*	x		
Lepyrus sp.		x	
Grypidius cf. *G. eguiseti* Fab.		x	
Notaris sp.		x	
Lixellus sp.			x?
Cleonus sp.			x
Ceutorhynchus sp.	x	x	

[1] Identified by D. H. Kavanaugh, California Academy of Science.
[2] Identified by H. Goulet, University of Alberta.
[3] Identified by T. L. Erwin, U.S. National Museum of Natural History, Washington, D.C.
[4] Identified by J. M. Campbell, Biosystematics Institute, Ottawa.
[5] Identified by H. S. Dybas, Field Museum of Natural History, Chicago.
[6] Identified by R. L. Wenzel, Field Museum of Natural History, Chicago.
[7] Identified by E. C. Becker, Biosystematics Institute, Ottawa.
[8] Identified by D. G. Kissinger, Loma Linda University, California.
*Extinct?

These late Tertiary beetle fossils also reveal some interesting distributional facts. For example it was a surprise to discover fossils similar to, if not conspecific with, the eastern north American ground beetle *Notiophilous aeneus* in the Lava Camp assemblage from western Alaska. Similarly *Dromius ruficollis* and *Phosphuga atrata,* 2 species to which several of the fossils are compared, are presently Palaearctic in distribution, and the histerid *Platysoma* fossil is most similar to species which presently occur in Europe and Siberia (R. L. Wenzel, pers. comm., 1976).

The closest relatives to many of the Meighen Island beetle species live today near the forest-tundra boundary (Hudsonian zone); similar environmental conditions are implied by the plant fossils (Hills and Matthews 1974; Matthews 1976a). In spite of this fact, some of the taxa listed for

Meighen Island (e.g., *Chlaenius, Georyssus,* the *laevifasciatus* group of *Dyschirius*) are not represented in the forest-tundra ecotone fauna of today, suggesting that the late Miocene Hudsonian fauna was more diverse than at present. Equally as intriguing as the fact that Meighen Island was near the forest limit in late Miocene time, is the implication from paleomagnetic studies (Symons 1969) that the Island was then, as now, within a high latitude region. This fact shows how different the late Miocene climate of the far north must have been from that of the present or even the warmer intervals of the Pleistocene.

Such findings are basically of a paleoecological sort, and though interesting are not the most significant from an entomological standpoint. For the entomologist the greatest promise of the fossils is what evolutionary information they will reveal. However, before some of the specimens can be examined in this light, more must be known about the present Hudsonian fauna. One of the purposes of this paper is to show, by listing fossils that have been found and illustrating their state of preservation, that entomologists can contribute significantly to study of the fossils if, in their taxonomic revisions, they attempt to analyze or at least discuss characters that are likely to be preserved on the fossils. Entomologists can contribute to the study of the fossils in another fundamental way, by simply including in their taxonomic analyses comments on evolutionary implications. Since the fossils discussed here are so obviously related to existing taxa, part of the paleontologist's job entails study of these extant species for the purpose of discovering characters of potential evolutionary significance. The task is simplified and the data more reliable if such conclusions form part of the original taxonomic treatment of a group. The ideal situation is a revision which includes a detailed phylogenetic construct (e.g., Whitehead 1972; Ball 1975), ready for testing and refinement by study of the relevant fossils.

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COLEOPTERA ASSOCIATED WITH AN *HYPOXYLON* SPECIES (ASCOMYCETES: XYLARIACEAE) ON OAK

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Abstract

Fifteen beetle species representing 10 families were found under bark of a live oak (*Quercus virginiana*) blown down one year previously. Nearly all were evidently feeding on conidia or stromatic tissue of the ascomycete fungus *Hypoxylon,* a habitat which is briefly discussed. Published European records of beetles from similar hosts in *Hypoxylon* and *Daldinia* are summarized, along with some additional records of beetles from these hosts in North America. Additional study of these fungi may shed light on the feeding habits of many of the smaller cucujoid Coleoptera.

On September 17, 1976 on Skidaway Island, near Savannah, Georgia, a number of adult and larval beetles were collected on the surface and just under the outer bark of a live oak (*Quercus virginiana* Mill.) which had been blown down by wind the year before. The beetles were associated with the flat stromata (fruiting structures) of an ascomycete fungus, some of which were covered with conidia (asexual spores), and were located either on these stromata or under raised portions of bark surrounding them. E. S. Lutrell of the University of Georgia and J. D. Rogers of Washington State University identified the fungus as a species of *Hypoxylon* in the Section Applanata and probably *Hypoxylon atropunctatum* (Schweinitz ex Fries) Cooke. Samples were taken back to Cambridge, and additional specimens were reared out in the laboratory. Fifteen species of Coleoptera were found in association with this fungus, and 8 of these were present as immatures. In addition, 1 species of Lepidoptera, 2 Hymenoptera, and 6 or 7 Diptera were collected in small numbers, but these are not treated further in the present account.

The life cycles of many Ascomycetes are complex, and the terminology employed may be found in a general text, such as Scagel *et al.* (1965). According to Rogers (personal communication), this particular fungus has a bipartite stroma, the outer part of which is thrown off with the bark, leaving the exposed, brownish, stromatic tissue. The latter produces masses of conidia, which give the surface a dull greenish-gray appearance. The bark surrounding the exposed stroma was often slightly raised, and pockets of moisture were present beneath the bark. Most of the beetles were hidden beneath the bark, but tracks could be seen where they crossed the conidial patches in feeding. The outer section of the stroma consists of 2 layers of brownish, pseudoparenchymatous cells in between which is a layer of whitish tissue.

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Beneath the outer section is a thicker layer of blackish stromatic tissue in which are embedded the immature perithecia. The surface conidia appeared to be the *Nodulisporium* type according to Lutrell (personal communication).

As will be seen below, many of the beetles were feeding on the abundant conidia, but some were taking in stromatic tissue or even hyphae. In addition to the *Hypoxylon,* a lichen was present on the bark surface, and fruiting bodies of *Stereum ostrea* (Blume and Nees) Fries occurred on various parts of the tree. The following is an annotated list of the Coleoptera collected:

TROGOSITIDAE.

Tenebroides sp. 3 larvae (keyed out in Crowson 1964). Gut sample contained no recognizable material; granular matter only. At least some species in the genus are known predators.

NITIDULIDAE.

Prometopia sexmaculata (Say). 8 larvae (illustrated in Böving and Craighead 1931). Gut sample contained large numbers of conidia, several pieces of stromatic tissue, and a few hyphae.

RHIZOPHAGIDAE: MONOTOMINAE.

Bactridium ephippigerum (Guérin-Méneville). 42 adults, 50 larvae (reared). Gut samples contained much stromatic tissue with a few hyphae and conidia.

CUCUJIDAE: LAEMOPHLOEINAE.

Laemophloeus biguttatus (Say). 36 adults, 30 larvae (reared). Gut samples consisted almost exclusively of conidia.

CORYLOPHIDAE.

Molamba lepida (LeConte). 1 adult.

LATHRIDIIDAE.

Enicmus maculatus LeConte. 9 adults, 7 larvae (reared). Gut sample contained only conidia.

BIPHYLLIDAE.

Diplocoelus rudis LeConte. 1 adult under bark, but not in immediate vicinity of stromata.

MYCETOPHAGIDAE.

Litargus sexpunctatus (Say). 16 adults, 30 larvae (reared). Gut samples consisted almost exclusively of conidia. The elytral pattern of most individuals is not typical for the species, in that there are 2 additional spots on each elytron.

Litargus balteatus LeConte. 3 adults.

COLYDIIDAE.

Aulonium parallelopipedum (Say). 1 adult, 1 larva? This larva is superficially similar to that of *Aulonium tuberculatum* LeConte and *A. longum* LeConte, but it is somewhat more flattened with much finer tergal carinae. It could also be the larva of *Eulachus carinatus* LeConte, since the affinities of that species are in doubt.

Eulachus carinatus LeConte. 2 adults.

Synchita fuliginosa Melsheimer. 1 adult.

Bitoma quadriguttata Say. 1 adult.

Bitoma quadricollis Horn. 20 adults, 11 larvae (reared). Gut samples included mainly stromatic tissue, with some hyphae and very few conidia.

SCOLYTIDAE.

Hypothenemus eruditus Westwood. 1 adult.

The flattened and thus less conspicuous stromata of certain *Hypoxylon* and other Ascomycetes may well be a common habitat for a number of species of rhizophagids, cucujids, lathridiids, mycetophagids, and colydiids, which are usually recorded as occurring under chips of outer bark or on bark surfaces. In this particular sample, *Prometopia, Laemophloeus, Enicmus,* and *Litargus* appeared to be specializing on conidia, while *Bactridium* and *Bitoma* were feeding primarily on stromatic tissue. It is possible, however, that this reflects the distribution of conidia-producing surfaces in any one area of the bark. The conidial surface is an ephemeral habitat, since it is soon eaten or worn off any particular patch of stroma. The same beetles may be able to subsist on the worn stromatic surface, and these or perhaps a new set may utilize the mature perithecia. The Lathridiidae are known to be spore specialists, but the feeding habits of the other families are variable or not very well documented. The single specimens of *Molamba* and *Diplocoelus* may be significant, since the Corylophidae are spore feeders and the Biphyllidae have been associated with other xylariaceous fungi; the occurrence of the bark beetle *Hypothenemus*, on the other hand, is fortuitous.

In the European literature, several beetle species have been recorded from *Hypoxylon* species and from the related xylariaceous fungus *Daldinia concentrica*. These records may be summarized as follows:

CRYPTOPHAGIDAE.

Cryptophagus dentatus Herbst and *Cryptophagus ruficornis* Stephens on *Daldinia concentrica* (Bolton ex Fries) Cesati and Notaris (Donisthorpe 1935; Hingley 1971).

BIPHYLLIDAE.

Diplocoelus fagi Guérin-Méneville on *Hypoxylon fuscum* Persoon ex Fries (Donisthorpe 1935).

Biphyllus lunatus (Fabricius) on *Daldinia concentrica* (Crowson and Hunter 1964; Donisthorpe 1935; Hingley 1971).

MYCETOPHAGIDAE.

Mycetophagus atomarius Fabricius on *Daldinia concentrica* (Hingley 1971) and on *Hypoxylon deustum* (Hoffman ex Fries) Greville (Crowson 1960).

Litargus connexus (Geoffroy) on *Daldinia concentrica* (Hingley 1971).

COLYDIIDAE.

Cicones variegatus (Hellwig) on *Hypoxylon duestum* (Donisthorpe 1935).

ANTHRIBIDAE.

Platyrrhinus resinosus (Scopoli) on *Daldinia concentrica* (Crowson and Hunter 1964; Donisthorpe 1935).

In Hingley's study of known age *Daldinia* stromata, *Biphyllus lunatus, Cryptophagus ruficornis,* and *Mycetophagus atomarius* were present during periods of active spore dispersal, while *Litargus connexus* and *Cryptophagus dentatus* were present in older stromata.

In North America, adults (one of which was teneral) of *Litochropus scalptus* Casey (Phalacridae) were collected in the stroma of *Daldinia concentrica* in Vermont, while an unidentified phalacrid larva was taken in the same fungus in Massachusetts. Adults and larvae of *Litochropus clavicornis* Casey were found on the stromata of *Daldinia simulans* in Texas. This same fungus produced adults and larvae of *Placonotus illustris* Casey(?) (Cucujidae: Laemophloeinae), *Litargus balteatus* LeConte, and a species of *Tenebroides*. A closer examination of *Daldinia, Hypoxylon,* and other ascomycete fungi may well shed light on the feeding habits of many of the smaller cucujoid Coleoptera.

Thanks are given to J. D. Rogers and E. S. Lutrell for their identifications and useful information on the fungus hosts, to T. F. Hlavac for comments and suggestions, and to David Miller of Skidaway Institute for pointing out the habitat and suffering the ravages of the other 200 chiggers, which otherwise would have shared me with their friends. Part of this research was conducted with the aid of an N.S.F. grant BMS 7502606.

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LITERATURE REVIEW

Labelling and storing an insect collection (4-H members' guide M-6-7), by Robert Dirig. 1977. New York State College of Agriculture and Life Sciences, Mailing Room, Building 7, Research Park, Cornell University, Ithaca, NY 14853. Paper cover, 21p., $1.25.

Robert Dirig has prepared a truly outstanding instructional pamphlet, on labelling and storing insects, for 4-H members and leaders. The scientific value of insect collections is discussed and very detailed instructions for meaningful labelling are presented. The importance and sources of maps, pens, and even a miniature printing press are described and illustrated. Instructions for proper pinning and storing of specimens are included. The author lists several regions in New York State where little collecting has been done in the past. It is interesting to note that well known resort areas such as the Catskills and the Adirondacks are in need of serious collecting. This guide may have been written for 4-H members, but it undoubtedly will be used by many entomologists (including amateurs and professionals). It is an excellent buy at the price listed!

—P.P.S.
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LIFE HISTORY OF *CTENOCOLUM JANZENI* (COLEOPTERA: BRUCHIDAE) IN SEEDS OF *PISCIDIA MOLLIS* (LEGUMINOSAE)

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Abstract

Ctenocolum janzeni females glue their eggs to the surface of the indehiscent fruits of *Piscidia mollis.* The larvae, upon hatching, enter the fruit directly beneath the egg, consume about 0.75 of a seed while molting several times and then pupate inside a single seed. The adults leave through the seed coat and then the pod valve. Under optimum conditions, and as long as seeds are available, *C. janzeni* continues to reproduce in culture. At least 3 generations were completed and 29.9% of the seeds collected were consumed. No parasitoids were reared from any of the cultures. It is suggested that, because *Piscidia mollis* occurs in fairly dense stands, host and host plant scarcity due to diversity and spatial distribution does not account for the lack of parasitoids. The parasitoids may be absent because (1) we are observing a period after a drastic reduction in the bruchid population and the parasitoids have not yet returned; or (2) the coevolutionary race has been temporarily won by the bruchids due to a buildup of resistance by the bruchids to parasitoids.

Introduction

As with several recent taxonomic revisions of New World Bruchidae, the paper by Kingsolver and Whitehead (1974) has made available names for bruchids that have much interesting ecological and behavioral data compiled for them. These data, when published, can be compared and many basic biological theories put forth to account for host preferences, host specificity, coevolution, etc. This is the case with *Ctenocolum janzeni* Kingsolver and Whitehead, which spends its larval life in the seeds of *Piscidia* spp. (Table 1). I am specifically concerned here with the interrelationships between *C. janzeni* and *Piscidia mollis* Rose.

C. janzeni has a distribution from Sonora and Tamaulipas, Mexico, to Puntarenas, Costa Rica. Presumably all of its hosts are in the genus *Piscidia.* According to Kingsolver and Whitehead (1974) all known hosts for species of *Ctenocolum* are in the legume genera *Piscidia, Lonchocarpus, Muellera,* and *Bergeronia.* According to Heywood (1971) the first 3 genera are in the subtribe Lonchocarpeae, tribe Dalbergieae, and, contrary to Kingsolver and Whitehead (1974), who place it in Lonchocarpeae, *Bergeronia* is in the subtribe Aeschynomeneae, tribe Hedysareae.

Methods

The rearing data in this paper were accumulated using the methods of Johnson (1970). In this paper C. D. Johnson is abbreviated CDJ.

Table 1. Host plants and collection localities of *Ctenocolum janzeni*.

Old Records: Kingsolver and Whitehead, 1974: *Piscidia grandiflora* (Donn. Sm.), *P. mollis* Rose, *P. carthagenesis* Jacq.

New Records: *Piscidia mollis*: Mexico. Sonora: ca 400', Lake Mocuzari, 22-XII-76 (CDJ #140-76, #142-76); ca 500', 8 mi S Lake Mocuzari, 22-XII-76 (CDJ #150-76); 21 mi NW Alamos, 23-XII-76 (CDJ #160-76).

Table 2. Emergence data for *Ctenocolum janzeni* in fruits of *Piscidia mollis* as of 16-VII-77

Culture #	Date Emerged By	Number of Bruchids Emerged
140-76	31- I-77	14
	23- II-77	20
	30-III-77	30
	27- IV-77	56
	25- V-77	5
	16-VII-77	34
142-76	31- I-77	5
	23- II-77	4
	30-III-77	8
	27- IV-77	16
	25- V-77	10
	26- V-77	2
	16-VII-77	19
150-76	23- II-77	6
	2- V-77	8
	25- V-77	1
	26- V-77	1
	16-VII-77	29
160-76	23- II-77	19
	31-III-77	7
	2- V-77	66
	25- V-77	7
	26- V-77	2
	16-VII-77	119

Table 3. Percentage infestation of seeds of *Piscidia mollis* by *Ctenocolum janzeni* as of 16-VII-77.

Culture #	number of seeds	number of bruchids	percent infestation
140-76	346	159	45.9
142-76	176	64	36.4
150-76	475	45	9.5
160-76	635	220	34.6
Total	1632	488	29.9

Results and Discussion

According to Shreve and Wiggins (1964), *Piscidia mollis* is a tree 3-9 m tall with a rounded, moderately dense crown; with pods (fig. 1) 2-10 cm long, 3.5-5 cm wide, 1-6- seeded, indehiscent, 2-winged on each suture, the wings several times as broad as the body, the pods breaking transversely with age (fig. 2A); and the seeds (fig. 3) are buff, about 1 cm long and 4-5 mm wide. My observations agree with theirs except that the seeds vary to dark brown. Most pods have 3-4 seeds in them and the seeds are separated from each other by ingrowth of the pod valves. The mature dry fruits remain on the trees for several weeks. The tree grows on dry hillsides, bajadas, and near streamways from near Ures southward to Alamos, Sonora, in the inner foothills. Kingsolver and Whitehead (1974) report records from within the above range and southward into Sinaloa. I have observed it to be locally abundant in areas disturbed by agriculture and grazing near Lake Mocuzari and Alamos. Most likely the unique winged segments (fig. 2A), each containing a seed, are dispersed by the wind.

Piscidia is a fabaceous legume in the tribe Dalbergieae, subtribe Lonchocarpeae (Heywood 1971). The genus *Lonchocarpus* is the only other plant genus in this subtribe known to harbor bruchids in northwestern Mexico. The related genera *Muellera* and *Pterocarpus* are known hosts for bruchids in South America and Costa Rica (Kingsolver and Whitehead 1974; J. M. Kingsolver, *in litt.*).

All 4 samples of *P. mollis* seeds collected in 1976 (Table 1) were fed upon by *C. janzeni* (Table 2). Two samples of seeds from the same general vicinity were collected in February 1973 but no bruchids were reared from them nor were there bruchid eggs nor bruchid damage. This is an example of patchy infestations by bruchids, not an unusual phenomenon. All fruits in the 6 samples were mature when collected.

Several seeds and fruits fed upon by *C. janzeni* were examined and then dissected to learn something about the behavior and ecology of *C. janzeni.* Eggs are oviposited singly or in groups on the lateral margins of the pod valves and on the wings (figs. 2e, 4e). (One exposed seed in a culture had eggs (fig. 3e) on it.) The eggs are attached directly to the pod with a small amount of adhesive beneath the egg (fig. 4e). The larvae burrow directly from the egg, through the pod wall, and enter a seed. A small amount of frass is left behind in the empty egg chorion. Several eggs may be laid on the pod valve above a seed but only one adult emerges from a seed, indicating that cannibalism most likely occurs among the larvae.

The larvae consume about 0.75 of a seed, molting several times in the process. Their frass and cast skins are used to line the inside of the seed, which serves as a pupal chamber. The adults emerge through a typical, round exit hole in the side of the pod valve (figs. 1, 2B, C). Often several seeds in the same pod are fed upon by different individuals of *C. janzeni* (fig. 1).

The first emergence from seeds was noticed about one month after the seeds were collected (Table 2) and emergence continued for about 6 months. The peaks of emergence for culture 140-76 and 160-76 were near

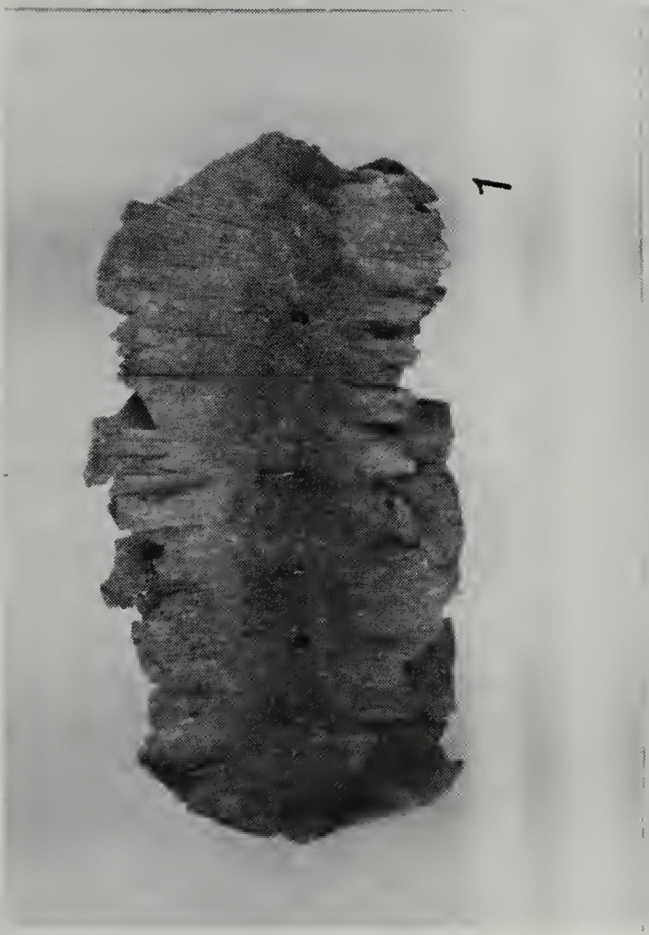
May 1 and July 16. This species is a continuous breeder, and the peaks of emergence represent a second and third generation in culture. Presumably, under optimum conditions in nature, this tropical species continues to feed in the seeds of its host as long as the seeds are available since the bruchids are still active in all 4 cultures as of 1 Sept. 1977. Probably the pod sections break apart under natural conditions and wings on each section allow some seeds to be dispersed before all are destroyed.

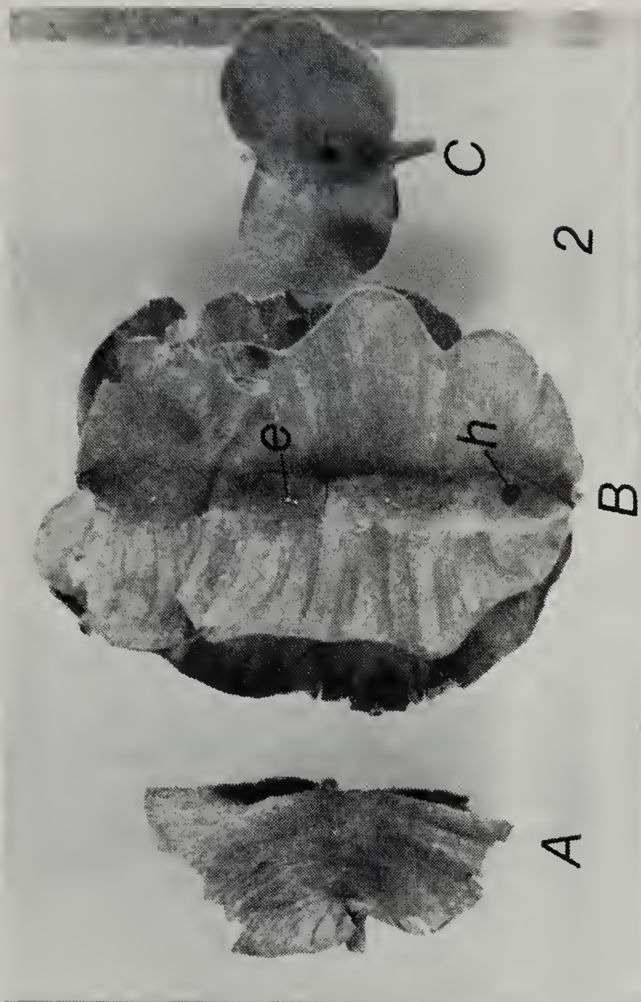
A fairly high percentage of the seeds of *P. mollis* are destroyed by *C. janzeni* (Table 3). The seeds collected at Lake Mocuzari and northwest of Alamos (140-76, 142-76, 160-76) were much more heavily infested than was the other culture. Even so, an overall percentage infestation of 29.9 is high compared to bruchids in *Nissolia* (Johnson 1978a), *Condalia* (Johnson 1978b), and *Cassia* (Johnson and Slobodchikoff 1978). There are no obvious morphological differences between pods in the 4 cultures, so perhaps the differences in percentage infestation may be attributed to a low initial infestation or possibly to differences in amounts of toxic chemicals in seeds between plants.

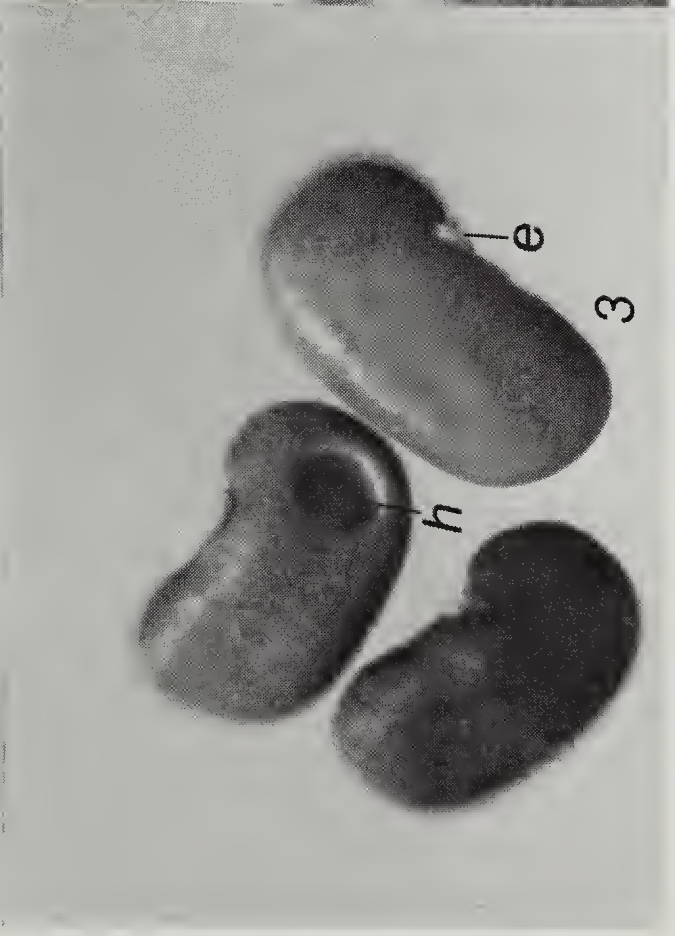
No other seed-feeding insects or parasitic Hymenoptera were reared from these cultures, although the eggs may be parasitized (fig. 4e). A bruchid population which lacks parasitoids is not a unique event (Johnson and Kingsolver 1971; Janzen 1975), rather it seems to be common for many tropical bruchids to be free of parasitoids (Janzen 1975). Janzen (1975) attributes the relative freedom from parasitoids for tropical bruchids in Guanacaste Province, Costa Rica, to a number of factors. One factor is that bacterial disease organisms feed on some bruchid larvae and perhaps feed on the parasitoid or outcompete it. Another factor is that in a habitat with a great deal of diversity (i.e., tropical Guanacaste) there are many more species of bruchids in a greater diversity of seeds, therefore it is more difficult for parasitoids to find the fewer bruchids of each species. Thus, being higher in the food chain, the parasitoids must use a greater diversity of hosts or specialize in order to survive. Consequently, any major disturbance to the habitat will have a proportionally greater effect on organisms higher in the food chain. Therefore, if a seed crop is not produced in a given year then the bruchid population will theoretically go to extinction or be drastically reduced. The specialist parasitoid will almost certainly become extinct and will be the last to recolonize an area after seed crops are produced and the bruchids have returned. The generalist parasitoid will theoretically be affected only if all or most of its hosts are reduced in number because it has alternative hosts.

The lack of parasitoids in bruchids in seeds of *P. mollis* is difficult to explain because *P. mollis* is common in southern Sonora and may be locally abundant. If the trees were widely dispersed then this lack of parasites could be explained on the difficulty of a parasitoid finding enough suitable bruchid hosts. Because the trees are locally abundant, in theory, at least, parasitoids should have colonized the bruchid population and reached an equilibrium with them if lack of diversity is one of the major criteria for parasitism.

It is possible that what appears to be a circumstance where there are no parasitoids at any point in time is merely a period of time after a drastic reduction of the bruchid population and the parasitoids have not yet recolonized that area.







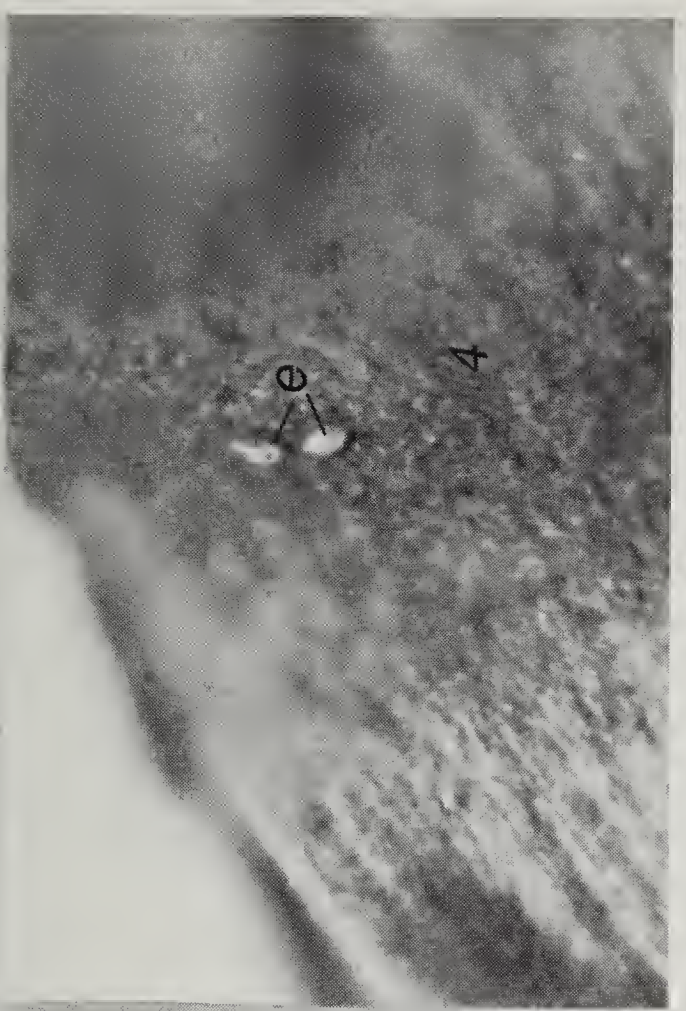


Fig. 1: Mature winged fruit of *Piscidia mollis* with 2 exit holes of *Ctenocolum janzeni* in the fruit valve. Fig. 2: A, Winged segment of fruit of *P. mollis* containing a seed and resulting from a transverse break in fruit; B, Entire fruit with 4 seeds, eggs (e) and exit hole (h) of *C. janzeni*; C, One-seeded fruit of *P. mollis* with exit hole of *C. janzeni*. Fig. 3: Seeds of *P. mollis* with egg (e) and exit hole (h) of *C. janzeni*. Fig. 4: Eggs of *C. janzeni* glued to surface of pod of *P. mollis*.

Because populations of bruchids and their parasitoids are in a coevolutionary race with each other, it is very possible that at any point in time we are observing a mere segment of a change that is occurring in nature. Perhaps what we see when bruchids (or seeds for that matter) are not preyed upon by parasitoids is that the coevolutionary race has been temporarily won by the bruchids (or seeds) through physiological or ecological resistance. Presumably, in time, the parasitoids will re-establish themselves in *C. janzeni* and the coevolutionary race will begin again.

I have offered several possibilities to explain the lack of parasitoids in *C. janzeni*. Hopefully these will be of heuristic value in stimulating more research on this interesting phenomenon.

Acknowledgments

I am grateful to Margaret and Rod Johnson for assisting with the field work and to Ellen Conroy and Joel Floyd for laboratory and curatorial assistance. I thank J. L. Strother for identifying the plants for me. Partial support for collecting was provided by the Insect Identification and Beneficial Insect Introduction Institute, U.S. Department of Agriculture under Grant 12-14-100-9970 (33).

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A REVIEW OF THE TAXONOMIC AND DISTRIBUTIONAL RELATIONSHIPS OF *PLEOCOMA HOPPINGI* FALL AND *PLEOCOMA RUBIGINOSA* HOVORE (COLEOPTERA:SCARABAEIDAE)

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Abstract

Distributional data for the *Pleocoma hoppingi—Pleocoma rubiginosa* species complex are recorded, and clinal character tendencies are discussed. Structural and meristic characters utilized in species differentiation are analyzed, and the antennomeres for the known population samples of both species are characterized. *P. r. transsierrae* is described as new, and a description is presented for the female of *P. r. rubiginosa*. Comparisons are given between females of *P. hoppingi* and *P. rubiginosa*, and the problems inherent in *Pleocoma* female differentiation are discussed.

Pleocoma hoppingi Fall and *Pleocoma rubiginosa* Hovore together comprise a species complex structurally distinct from the remainder of the genus. Both species have the integument and pubescence uniformly pale reddish-brown, the pronotal surface densely, coarsely punctate-pubescent, and the ocular canthi subquadrate in dorsal outline; both are presently known only from moderate to high elevations in the Sierra Nevada of California (Fig. 1). *Pleocoma hoppingi* appears to be more or less continuously distributed on the western slope from Calaveras County south to central Tulare County. *Pleocoma rubiginosa* has been collected on the western slope of the Sierra Nevada in southern Tulare County and northern Kern County, then eastward at several localities on the Kern Plateau and along the eastern slope as far north as southern Mono County.

Hovore (1977) discussed some aspects of phenotype variation in several species of *Pleocoma* and suggested that many populations previously regarded as full species are actually variants from within widely distributed polytypic species. The present study was undertaken to better define the relative status of *P. hoppingi* and *P. rubiginosa* and to assess the taxonomic value of the presently used differentiating characters. Both species were very poorly represented in collections, most material being old and often damaged to such an extent as to be taxonomically useless. However, available locality data indicated that both species had been collected at relatively accessible locations. It soon became evident that difficulties in collecting insects at high elevations during inclement weather, rather than rarity of the species in nature, had accounted for the scarcity of museum specimens. Improved roads and greater availability of electricity for lights facilitated the search, and soon, numerous "populations" had been sampled.

Although each sample exhibited a slightly different set of quantitative character states, a constant series of structural differences was found by which samples could be objectively assigned to either "typical" *P. hoppingi* or "typical" *P. rubiginosa*. Moreover, samples of *P. hoppingi* exhibited a relatively uniform south-to-north clinal reduction in the antennal formula, whereas *P. rubiginosa* appeared to be divided into two widely distributed but allopatric phenotypic groupings. The nominotypical phenotype of *P. rubiginosa* occurs over most of the known distributional range for the species, but a group of small, isolated populations from Mono and Inyo Counties differ sufficiently to be recognized as a distinct subspecies, described herein.

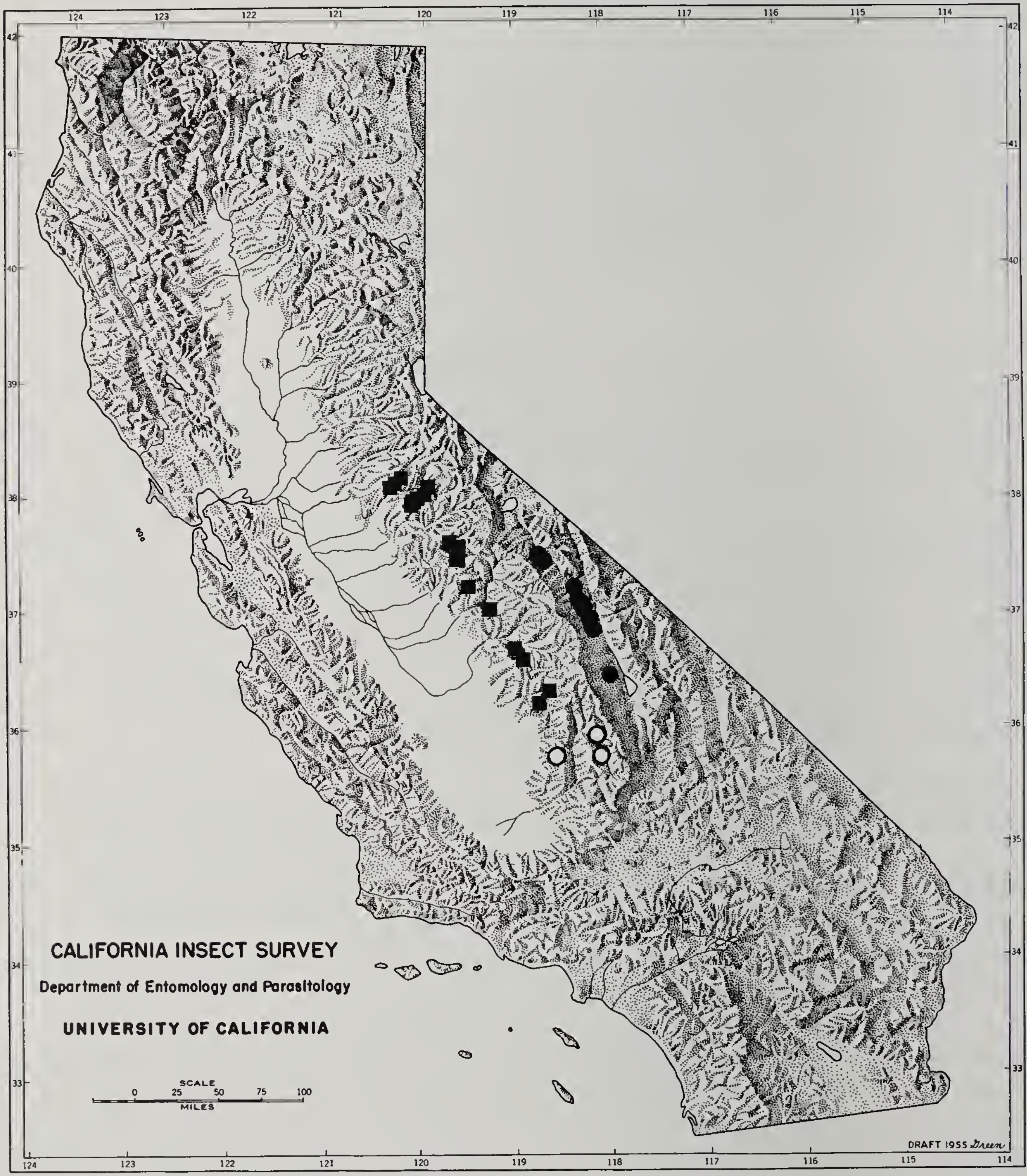


Fig. 1. Distribution map of *Pleocoma hoppingi* (shaded squares), *Pleocoma r. rubiginosa* (open circles), and *P. r. transsierrae* (shaded circles).

The close superficial resemblance of *P. hoppingi* to *P. rubiginosa*, along with similarities of habitat preference and season of adult activity, indicate a common progenitor. However, males of the two taxa are readily distinguished by a number of apparently qualitative anatomical features (Table 1), indicating complete speciation. These characters are remarkably constant in the material examined, with little significant interpopulational variation. The sculpturation of the ocular canthi and relative development of the head structures, though differing in degree of variability from sample to sample, generally substantiate species differentiation. In *P. hoppingi* the ocular canthi usually project at a right angle to the midline of the head, with the anterior margin strongly sinuate and the apex slightly emarginated (Fig. 4); the ocular canthi of *P. rubiginosa* usually project slightly forward from a right angle, with the anterior margin only very feebly sinuate and the apex truncate or rounded (Fig. 5). In both species the ocular canthi are subquadrate, a condition not found thus far in the remainder of the genus. Also, male *P. hoppingi* have the head structures reduced in size (Fig. 6), whereas nominotypical *P. rubiginosa* have the head structures very pronounced (Fig. 7).

Discussion of Variation in males of *P. hoppingi*.

Population samples examined of *P. hoppingi* displayed a south-to-north clinal reduction in the number of long lamellae comprising the antennal club, with coincidental reductions in the lengths of the intermediate lamellae. Briefly, male antennal formulae for the known population samples are characterized as follows:

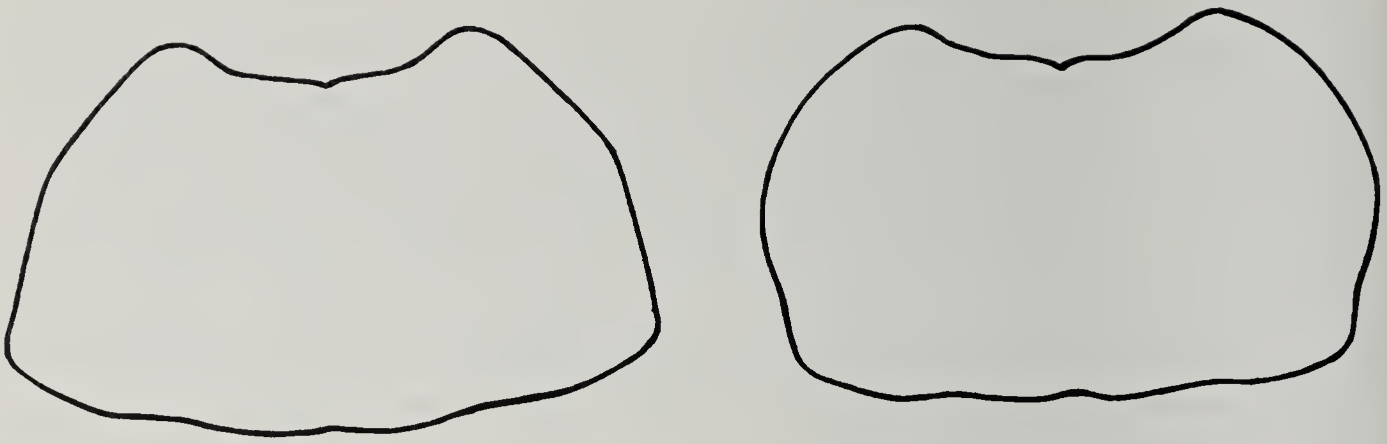
Tulare County, "South fork of the Kaweah River" (Type locality): segment 3 strongly flattened anteroventrally, segment 4 with lamella from 1/3 to 1/2 as long as that of segment 5, lamella of segment 5 only slightly shorter than that of segment 6, lamellae of segments 7 to 11 more or less subequal (based upon holotype and 6 cotypes).

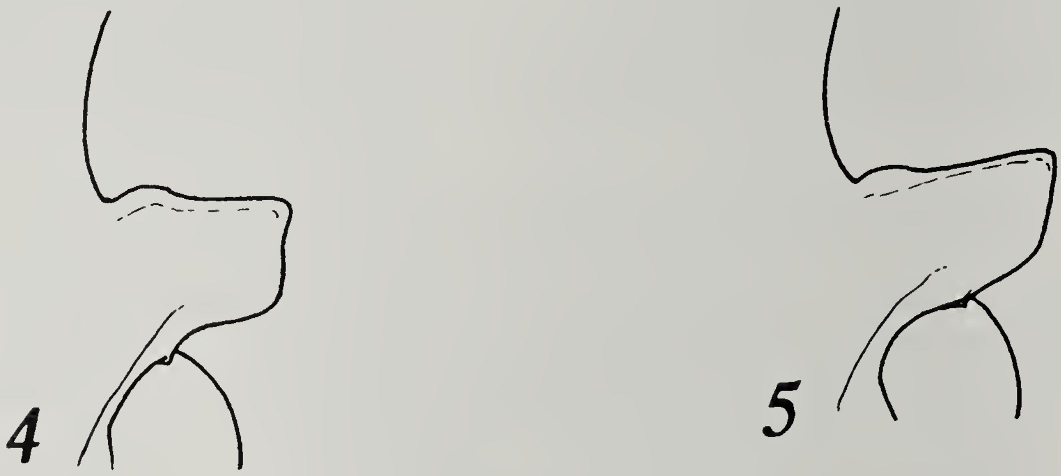
Tulare County, "Mineral King road, above Hammond": segment 3 strongly flattened anteroventrally, segment 4 with lamella nearly 2/3 as long as that of segment 5, lamella of segment 5 only slightly shorter than that of segment 6, lamellae of segments 7 to 11 more or less subequal (1 specimen).

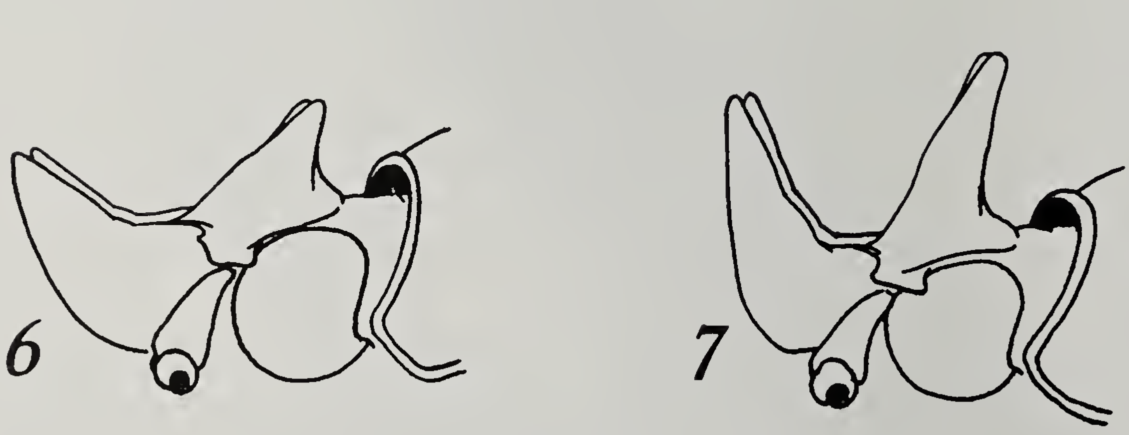
Tulare County, 1 mi WSW Eshom: segment 3 flattened anteroventrally, segment 4 strongly transverse with moderate projection, lamella of segment 5 about 2/3 as long as that of segment 6, lamellae of segments 7 to 11 more or less subequal (1 specimen). One of two specimens examined from "Colony Road, Tulare County" has the antennae similar to those of the Eshom specimen.

Fresno County, Millwood: segment 3 angulated anteriorly, only slightly flattened, segment 4 transverse with a short projection, lamella of segment 5 about 2/3 as long as that of segment 6, lamellae of segments 7 to 11 more or less subequal (1 specimen). One of two specimens examined from "Colony Road, Tulare County" has the antennae similar to those of the Millwood specimen.

Fresno County, Shaver Lake: segment 3 angulated and flattened anteriorly, segment 4 with lamella slightly more than 1/2 as long as that of







Figs. 2-3. Dorsal view, pronotal outline of male *Pleocoma hoppingi* (2) and *Pleocoma rubiginosa* (3). Details of punctation and pubescence omitted.

Figs. 4-5. Dorsal outline of right ocular canthus of male *Pleocoma hoppingi* (4) and *Pleocoma rubiginosa* (5). Details of punctation and pubescence omitted.

Figs. 6-7. Left lateral outline of dorsal head structures of male *Pleocoma hoppingi* (6) and *Pleocoma rubiginosa* (7). Details of punctation, pubescence, mouthparts, and antennae omitted.

segment 5, lamella of segment 5 more than 7/8 as long as that of segment 6, segment 6 slightly shorter than segment 7, lamellae of segments 7 to 11 more or less subequal (1 specimen).

Madera County, 2.5 mi S Bass Lake: segment 3 broadly flattened and angulated anteriorly, segment 4 with short lamella, slightly less than 1/2 as long as that of segment 5, lamella of segment 5 only slightly shorter than that of segment 6, lamellae of segments 7 to 11 more or less subequal (1 specimen).

Mariposa County, Miami Ranger Station, near Fish Camp; Cascades area and Foresta, Yosemite National Park: segment 3 usually flattened anteriorly, segment 4 strongly transverse, acutely angulated or with short projection, segment 5 with lamella from about 1/2 to 3/4 as long as that of segment 6, lamella of segment 6 from 7/8 as long to subequal in length with lamella of segment 7, segment 7 slightly shorter than segment 8, lamellae of segments 8 to 11 more or less subequal (136 specimens).

Tuolumne County, Twain Harte; Confidence; Long Barn; Cold Springs; Dodge Ridge; Strawberry: segment 3 slightly flattened and angulated anteriorly, segment 4 moderately transverse, strongly angulated anteriorly, segment 5 strongly transverse with a short projection, segment 6 with lamella from 1/2 to 2/3 as long as that of segment 7, lamella of segment 7 about 7/8 as long as that of segment 8, segment 8 shorter than segment 9, lamellae of segments 9 to 11 more or less subequal (22 specimens).

Calaveras County, Hathaway Pines; Avery; Arnold and vicinity: segment 3 usually feebly flattened, angulated anteriorly, segment 4 moderately transverse, segment 5 strongly transverse, usually with a short projection, segment 6 with short lamella, from 1/2 to 2/3 as long as that of segment 7, lamella of segment 7 about 1/2 as long as that of segment 8, lamella of segment 8 distinctly shorter than that of segment 9, lamellae of segments 9 to 11 more or less subequal (41 specimens).

TABLE 1. Character state differences between males of *Pleocoma hoppingi* Fall and *Pleocoma rubiginosa* Hovore.

Pleocoma hoppingi	*Pleocoma rubiginosa*
Antennal segment 3 angulated anteriorly or with flattened anteroventral process.	Antennal segment 3 simple, elongate, subcylindrical.
Pronotal disc without median longitudinal impunctate line.	Pronotal disc usually with distinct median longitudinal impunctate line.
Elytral humeri with striae distinctly impressed and punctate, many punctures with long, erect hairs.	Elytral striae at humeri only feebly impressed, lightly punctate, glabrous or at most with few erect hairs.
Geminate striae on elytral disc distinctly impressed, regularly punctate.	Elytral striae feebly impressed, finely, shallowly, irregularly punctate.
Pronotum small (relative to overall body size), widest at posterior angles, posterior angles narrowly, obtusely rounded; sides distinctly tapering anteriorly from posterior to anterior angles (Fig. 2).	Pronotum robust, widest at or slightly behind middle, rarely at posterior angles, posterior angles broadly, evenly rounded; sides usually broadly convex between posterior and anterior angles (Fig. 3).
Body form usually narrowly oblong-oval, elytral sides subparallel.	Body form more broadly oval, elytral sides broadly rounded.

When a series of specimens was available from a single locality or contiguous localities, the antennal formulae displayed considerable minor variation, expressing transitional tendencies between geographically proximate samples along the south-north cline. The number of long lamellae seems relatively stable in Tulare and Fresno Counties, most variation being expressed in the development of the fourth segment, which in some individuals is long enough to create an octo-lamellate club. Characters such as the dorsal outline of the ocular canthi, relative pronotal and elytral proportions, or placement and size of pronotal impunctate areas also proved to be extremely variable both within and between samples. As material from areas geographically intermediate to the presently known localities becomes available for study, it is probable that the character transition between samples will continue to be consistent with the patterns reflected in the above characterizations.

Discussion of Variation in males of *P. rubiginosa*.

Within the material examined of *P. rubiginosa* there was a tendency toward a west-to-east reduction of the male antennal formulae. However, the presently known geographical distribution of this species is extremely fragmentary, and so it remains to be seen whether a true clinal pattern exists. I have records for this complex from Kernville, Walker Pass and the Piute Mountains, all in Kern County, but I have not yet been able to obtain or examine specimens from those localities.

Males of *P. rubiginosa* from the presently known localities are briefly characterized as follows:

Tulare County, 1 mi W Posey; 2 mi N Posey: form robust, length 22-29 mm; head structures very pronounced (Fig. 7), even in smaller specimens; antennae with segment 3 simple, elongate, subcylindrical, segment 4 short, transverse, slightly angulated anteriorly, segment 5 strongly transverse with a short to moderate projection, segment 6 with lamella from about 1/2 to nearly 3/4 as long as that of segment 7, lamella of segment 7 more than 4/5 as long as that of segment 8, lamella of segment 8 only slightly shorter than that of segment 9, lamellae of segments 9 to 11 more or less subequal (based upon holotype, 15 paratypes, and 15 topotypical specimens).

Tulare County, Lamont Meadows, 5,600 feet elevation: form robust, length 20.5-25 mm; head structures very pronounced; antennae with segment 3 simple or very slightly, evenly swollen apically, segment 4 short, simple or slightly angulated anteriorly, segment 5 acutely angulated anteriorly or transverse with short projection, segment 6 with short lamella, from about 1/3 to 1/2 as long as that of segment 7, lamella of segment 7 more than 4/5 as long as that of segment 8, segment 8 slightly shorter than segment 9 (12 specimens).

Tulare County: 1 mi S and 4 mi S Kennedy Meadows, 6,400-7,000 feet elevation: form robust, length 22-27 mm; head structures very pronounced; antennae with segment 3 simple, elongate, subcylindrical, segment 4 short, simple or very slightly angulated anteriorly, remainder of antennal formula as in Lamont Meadows sample (19 specimens).

Specimens at hand from Mono and Inyo Counties have the antennal formulae even further reduced, with corresponding reductions in the head structures and in overall size. This material, collected from isolated ridges and canyons high above the Owens Valley, is apparently geographically allopatric from other *P. rubiginosa* populations, and it is my opinion that recognition as a separate subspecies is warranted.

Pleocoma rubiginosa transsierrae Hovore, **new subspecies**

Male. Form moderately robust, broadly oblong-oval, convex, dorsum feebly flattened; integument reddish-brown, pubescence light reddish. *Head* with dorsal surface coarsely, irregularly rugoso-punctate, except for vague impunctate areas at posterior base of vertical horn and in transverse line between ocular canthi, punctate areas densely clothed with erect hairs; clypeal process small, constricted at base, only slightly reflexed apically, apex obtusely notched, apical angles acutely rounded; vertical horn stout, only moderately elongated, sides tapering from base to apical 1/3, then subparallel to apex, apex with acute median notch, apical angles acutely rounded, basal 2/3 coarsely punctate-pubescent, punctures elliptical; ocular canthi subquadrate (this character is subject to considerable distortion through abrasion), projecting slightly forward from a right angle with the midline of the body, anterior edge feebly sinuate; oblique supraorbital carina indistinct; palpi and antennae light reddish-brown; antennal scape stout, subconical, clothed with long stiff hairs, segment 2 moniliform, segment 3 elongate, slightly reflexed, slightly angulated anteriorly, segment 4 simple or feebly angulated anteriorly, segment 5 transverse, acutely angulated anteriorly or with short projection, segment 6 strongly transverse with moderate projection or short lamella, from about 1/3 to 1/2 as long as that of segment 7, lamella of segment 7 from slightly less than 1/2 to 2/3 as long as that of segment 8, lamella of segment 8 distinctly shorter than that of segment 9, lamellae of segments 9 to 11 more or less subequal in length. *Pronotum* usually less than twice as wide as long, usually widest at middle, sides broadly rounded, posterior angles broadly, obtusely rounded, lateral discal impressions feeble, maculate with piceous; disc moderately convex, anterior median surface broadly flattened, surface shining, coarsely, densely punctate except for narrow, median longitudinal impunctate line extending to anterior and posterior margins, entire surface densely clothed with long suberect hairs in unabraded specimens. *Scutellum* broadly rounded at apex, often impressed medially, surface irregularly, moderately coarsely punctate, clothed with long subrecumbent hairs. *Elytra* rich reddish-brown, transparent, shining, surface finely, shallowly punctate, glabrous, sutural striae moderately impressed, shallowly, irregularly punctate, geminate striae at margins of costae feeble, indicated only by single irregular row of fine, shallow punctures, costae impunctate; hairs of marginal fringe relatively short, straight. Length: 16.5-25 mm.

Holotype: Male; California, Inyo County, Coyote Creek, 7,900-9,000 feet, 5 February 1972, Derham Giuliani, collector (Deposited in the collection of the California Academy of Sciences, Entomology). *Paratypes* (65): California, Inyo County: 11 males, same data as holotype; 22 males, Big Pine Creek, 7,400-7,700 feet, various dates in November, December, January and February, 1971 to 1975, Derham Giuliani collector; 5 males, "near Scotty's Spring", 8,000 feet, 11 Feb 1972, D. Giuliani; 2 males, Scotty's Spring, 5,700 feet, 11 Feb 1972, D. Giuliani; 8 males, east slope Wonoga Peak, 8 mi S, 2 mi W Lone Pine, 6,400-7,200 feet, 17 Feb 1972, D. Giuliani; 1 male, Pine Creek, Round Valley, 6,800 feet, 9 Jan 1971, D. Giuliani; 1 male, Sawmill Creek, 6,300 feet, 22 Jan 1971, D. Giuliani; 1 male, 1 mi E Sacatar Pass, 6,800 feet, 23 Feb 1972, D. Giuliani; 2 males, Fuller Creek, 6,500 feet, 14 Jan 1975, D. Giuliani; Mono County: 1 male, Witcher Creek, 7,100 feet, 22 Dec 1972, D. Giuliani; 7 males, Witcher Meadow, 7,600 feet, 22 Dec 1972 (2), 15 Jan 1975 (5), D. Giuliani; 4 males, Sand Canyon, 2 mi S Tom's Place, 7,200-8,100 feet, 11 Mar 1972, D. Giuliani. Paratypes are on deposit in the author's collection; California Academy of Sciences; California Insect Survey Collection, University of California, Berkeley; California State Department of Agriculture; U. S. National Museum; Museum of Comparative Zoology, Harvard College; H. F. Howden collection; D. G. Marqua collection; P. H. Sullivan collection; R. L. Westcott collection; R. L. Penrose collection; D. C. Carlson collection.

Males of *P. rubiginosa transsierrae* differ from those of the nominotypical form primarily by the reduced antennal formula and the consistently reduced size of the head structures. These structural reductions do not appear to be allometric, as larger males of *transsierrae* (24-25 mm.) have much smaller structures than do the smallest specimens from the nominotypical population and Kern Plateau populations (22 mm.). It has not been possible to determine whether the smaller average size of *transsierrae* is a constant differentiating character or merely a generic response to the more severe environmental conditions encountered at very high elevations on the eastern slope of the Sierra Nevada.

The female of this subspecies is as yet unknown in its entirety; however, there is at hand one complete head plus several antennae, collected in Inyo County, Big Pine Creek, 4 Feb 1972, ex. Coyote scats, D. Giuliani. From these fragments it is possible to characterize the salient taxonomic features of the female head as follows: dorsal surface coarsely, irregularly punctate-pubescent, glabrous areas extending from posterior base of vertical horn laterally onto ocular canthi; clypeus reflexed apically, apical angles broadly rounded to median notch, median notch deep, broadly rounded, creating bilobed clypeal outline; eyes barely visible from above, surface slightly flattened; vertical horn reduced to pair of rounded tubercles, posterior basal impressions shallow, impunctate; ocular canthi very stout, subquadrate, anterior edge feebly sinuate, lateral edges slightly emarginated; supraorbital carina feeble, extending onto posterior base of ocular canthi; palpi and antennae light reddish-brown; antennal scape subconical, segment 2 moniliform, segment 3 simple, elongate, subcylindrical, segment 4 moniliform, slightly compressed anteriorly, segment 5 feebly transverse, angulated anteriorly, segment 6 strongly transverse with acute projection, segment 7 with a short lamella, from about 1/2 to 2/3 as long as that of segment 8, lamella of segment 8 slender, more than 4/5 as long as that of segment 9, segments 9 to 11 noticeably thickened, particularly along dorsal edge, more or less subequal in length.

Pleocoma rubiginosa rubiginosa Hovore

The female of *P. rubiginosa rubiginosa* was not known to me at the time of the original description (Hovore 1972), and it seems provident to present it at this time.

Female. Form very robust, broadly ovate, dorsum evenly convex or very slightly flattened; integument light reddish-brown, pubescence pale reddish. *Head* generally similar in all essential respects to that of the subspecies *transsierrae* (given above), except ocular canthi more produced laterally, only feebly quadrate or subtriangular in dorsal outline; antennae not differing measurably from those of *transsierrae. Pronotum* strongly, evenly convex, less than twice as wide as long, barely widest at middle, posterior angles broadly, obtusely rounded; discal surface shining, evenly, coarsely punctate except on narrow median longitudinal line, entire surface thinly clothed with short erect hairs in unabraded specimens. *Scutellum* broadly rounded at apex, surface lightly, coarsely punctate, thinly clothed with suberect hairs. *Elytra* rich reddish-brown, transparent, surface shining, finely, shallowly, irregularly punctate, geminate striae at margins of costae feebly impressed, finely, shallowly punctate, costae not or feebly elevated. Length: 22-27 mm. (Above description based upon a series of 5 females collected 1 mi S and 4 mi S Kennedy Meadows, Tulare County)

DISCUSSION OF FEMALE CHARACTERISTICS

The head structures of the females, due primarily to their already much-reduced condition, do not measurably reflect the populational differences exhibited by the males. I cannot find, in the small amount of material available for analysis, any reliable head structure or antennal differences between females of *P. r. transsierrae* and *r. rubiginosa* from near Kennedy Meadows on the Kern Plateau. Males from the Kern Plateau samples have slightly lower antennal formulae than do topotypical males, and it is possible that females from the latter population would be distinguishable from *transsierrae* on the basis of antennal characters. However, in other closely-related *Pleocoma* populations, where series of females have been available for comparison, most structural and meristic characters by which taxa might be differentiated are subject to considerable variation. Character variability, combined with the fact that all known *Pleocoma* females have pronounced anatomical simplification and structural reduction, often makes quantitative differentiation impractical.

Females of both *P. hoppingi* and *P. rubiginosa sensu latu* are very rare in collections, so comparisons made herein should be regarded as somewhat tentative. In the 3 females examined of *P. hoppingi* (allotype and 2 specimens from Calaveras County), the pronotum is widest at the posterior angles, with the sides gradually tapering to the anterior angles; the ocular canthi are distinctly subquadrate; the geminate striae at the elytral humeri are distinctly impressed and punctate, with numerous long, erect hairs arising from the larger punctures; the clypeal process is not so broadly expanded nor so strongly reflexed as in *rubiginosa*. These differences are essentially diminutives of those cited above for the males, and in series may well prove to be valid characters for distinguishing females of the two species.

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REMOVAL OF *MYCETOCHARA PUNCTICOLLIS* (BLATCHLEY) FROM THE ALLECULIDAE TO THE MELANDRYIDAE (COLEOPTERA)

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ABSTRACT

Mycetochara puncticollis (Blatchley) described from Florida is transferred from the family Alleculidae and provisionally assigned to the genus *Hallomenus* Panzer of the family Melandryidae.

Blatchley (1917, p. 276) described *Mycetochares puncticollis* from a single specimen from Dunedin, Florida. The type of this species was examined during the preparation of a review of the North American *Mycetochara* Berthold (formerly *Mycetochares* Latreille) (Campbell, in press). Unfortunately, this specimen is in extremely poor condition, but even a superficial observation reveals that it is not an alleculid.

The specimen is probably a male and is glued upside down on a card point. The antennae, 1 front leg and 1 protarsus, 1 middle leg and the ultimate 2 segments of 1 mesotarsus, and 1 middle leg and 1 metatarsus are missing. Most of the venter is obscured by glue including all details of the mouthparts. Additionally, the prothorax has been poorly reglued to the pterothorax in such a way as to obscure many of the ventral prothoracic characters. The specimen is labeled as follows: TYPE/Dunedin, Fla., W.S.B. Coll. 3-8.1913/ Mycetochares puncticollis sp. nov. It is in the Blatchley collection now housed at Purdue University, Lafayette, Indiana.

Unfortunately, the specimen was available for study for only a short time so that I was able to compare it only with specimens in the Canadian National Collection. Based on superficial dorsal structures, it seems similar in most respects to *Hallomenus scapularis* Melsheimer, but has a different color pattern (dark brunneopiceous dorsally with a large, circular, clearly defined, rufo-testaceous spot at humeral angle of each elytron).

As I am certain the species is not an alleculid, I have tentatively reassigned it to the genus *Hallomenus* Panzer. As most of the diagnostic characters for this genus are on structures that are missing (legs and antennae) or are obscured (mouthparts and venter of body), this assignment is questionable and the specimen should be closely re-examined whenever the species of the family Melandryidae or the genus *Hallomenus* are revised.

ACKNOWLEDGEMENTS

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FIRE ANT MYRMECOPHILES: NEW HOSTS AND DISTRIBUTION OF *MYRMECAPHODIUS EXCAVATICOLLIS* (BLANCHARD) AND *EUPARIA CASTANEA* SERVILLE (COLEOPTERA: SCARABAEIDAE)

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and J. W. Summerlin[2]

Abstract

New ant hosts and distribution records from Alabama, Florida, Georgia, Louisiana, Mississippi, and Texas are reported for *Myrmecaphodius excavaticollis* (Blanchard) collected from nests of *Solenopsis invicta* Buren (red imported fire ant), *S. richteri* Forel (black imported fire ant), *S. geminata* F. (tropical fire ant), *S. xyloni* McCook (southern fire ant), and *Iridomyrmex humilis* (Mayr) (argentine ant). New ant host and distribution records from Florida and Georgia are reported for *Euparia castanea* Serville collected from nests of *S. geminata* and *S. xyloni*. The occurrence of both species of beetle from the same nests of *S. geminata* and *S. xyloni* is reported for the first time. The range of *M. excavaticollis* is expanding while the range of *E. castanea* is decreasing. Both species of beetle occur in abandoned mounds of the host ants.

The myrmecophiles, *Myrmecaphodius excavaticollis* (Blanchard) and *Euparia castanea* Serville, were thought to be host specific to *Solenopsis invicta* Buren and *S. geminata* F., respectively, by Woodruff (1973) who reported the distribution of both species of beetle in Florida. Collins and Markin (1971) reported the distribution of *M. excavaticollis* only by state and used the now obsolete name *S. saevissima richteri* Forel for the host (shown by Buren, 1972, to be 2 species *S. invicta* and *S. richteri* Forel, in the United States).

In this paper we report new hosts and new distribution records for the 2 myrmecophilous scarabs.

Materials and Methods

Entire or partial colonies of ants were collected in the field and brought into the laboratory for study. These colonies were separated from the soil, and all myrmecophilous scarabs found are reported herein.

All colonies were collected in 5-gal buckets except those collected outside Alachua Co., Florida, in 1975. The remaining collections were made in 1-gal buckets. The inside rims of the buckets were dusted with talc to prevent the ants from escaping. Lids were placed on the buckets during transit to comply with quarantine regulations.

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In the laboratory the ants and any myrmecophiles were separated from the soil by dripping tap water into the buckets at a rate of ca. 1 drop/sec from medical intravenous fluid tubes. The ants moved their brood to the soil surface as the water slowly saturated the soil in the buckets until the ants, brood, and myrmecophiles floated on the water surface. They were then transferred to a dry container rimmed with talc. The myrmecophiles were found with the ants or swimming free in the water. However, all of the beetles collected from Florida: *Hillsborough Co.,* Plant City, Arizona Land and Cattle Co., were floated in the field by placing a steel drum, with the ends removed, around a mound and trickling in water until the mound was inundated. Also, all of the beetles collected from pastures or lawns in Georgia were hand picked from the ant mounds; flotation was not used on these mounds.

The following abbreviations are used in the list of collections: CTA, C. T. Adams; JDA, J. D. Atwood; WAB, W. A. Banks; DMH, D. M. Hicks; DPJ, D. P. Jouvenaz; JKP, J. K. Plumley; KHS, K. H. Schroeder; JWS, J. W. Summerlin; and DPW, D. P. Wojcik. All specimens are in the collection of DPW or were used in biological observations or experiments (Wojcik 1975). Multiple numbers in parentheses in the collection list indicate the number of beetles obtained from separate ant nests collected on the same date at that location, i.e., (3,2,4). Unless otherwise indicated, all ant nests were collected on road shoulders or opposing banks.

Results

In the Southern United States, 1920 specimens of *M. excavaticollis* were collected in association with 4 species of *Solenopsis* and 1 species of *Iridomyrmex,* and 655 specimens of *E. castanea* were collected in association with 2 species of *Solenopsis.*

Myrmecaphodius excavaticollis is common in mounds of the widespread *S. invicta.* The most recent distribution of *S. invicta* is given by Lofgren *et al.* (1975) and USDA (1976). Collins and Markin (1971) reported this beetle from AL, FL, GA, LA, MS, NC, and TX. Records given here are from 234 nests in AL, FL, GA, LA, MS, and TX.—Alabama: *Autauga Co.,* Jct. US-31 & I-65, 23-X-75, DPW & DMH (1); *Chilton Co.,* Clanton, 30-VI-73, DPW & WAB (2,1); *Conecuh Co.,* Evergreen, 8-XII-75, DPW (4,1); *Covington Co.,* Andalusia, 8-XII-75, DPW (4,1,2); *Dale Co.,* Ozark, 24-X-75, DPW & DMH (2,1); *Houston Co.,* Ashford, 24-X-75, DPW & DMH (2); *Jefferson Co.,* Graysville, 23-X-75, DPW & DMH (3); *Lee Co.,* Chewacla St. Pk., 30-VI-73, DPW & WAB (1), Opelika, 1-VII-73, DPW & WAB (3); *Mobile Co.,* Bucks, 18-VI-75, DPW (1 collected as larvae; 1); *Montgomery Co.,* Mt. Meigs, 30-VI-73, WAB & DPW (1); *Russell Co.,* Phenix City, 1-VII-73, WAB & DPW (1); *Shelby Co.,* Pelham, 30-VI-73, DPW & WAB (1), Shelby Co. airport, 23-X-75, DPW & DMH (14,6); *Tuscaloosa Co.,* Northport, 21-X-75, DPW & DMH (1). Florida: *Baker Co.,* on SR-121 10 mi S of Macclenny, 17-VII-73, DMH (1,4,1) Glen St. Mary, 7-VIII-73, DMH (1), 5-XII-73, DMH (1,4,1,1,1), 7-XII-73, DMH (4), Macclenny, 13-VIII-73, DMH (4,2,1,2,9); *Bradford Co.,* Brooker, 5-I-73, DPW (1), Lawtey, 23-VIII-72, DPW (1), 4-III-74, DMH (2), 24-IV-74, DPW (1,2,6; 1 teneral), 18-IX-74, DPW & DMH (1,4,1,1,1), Starke, all DPW, 9-I-73 (1,6,1,3), 1-IV-73 (1,3), 8-VI-73 (1), US-301 2 mi N of Starke, all DPW, 5-II-71 (17), 12-II-71 (3), 19-II-71 (2), US-301 3.2 mi N of Starke, 26-II-71, DPW (3 from abandoned mound; 2); *Calhoun Co.,* SR-20 at Chipola River, 9-XII-75, DPW (1); *Clay Co.,* Highlands, all DPW, 23-VI-70 (5,3,38,27,11), 16-VII-70 (9,7,4), 24-VIII-70 (1), 7-XII-70 (1,1), 14-XII-70 (27,1), 29-I-71 (3,5), Middleburg, 20-IX-75, DMH (3), 6-I-76, JKP & DMH (3); *Duval Co.,* Baldwin, 19-III-73, DPW (1), 12-VI-73, DPW (1), Cecil Field Naval Air Sta., 8-VII-70, DPW (3), Dee Dot Ranch, 2 mi W of Jacksonville Beach, 17-V-73, DPW (1), 20-VII-73, DPW (1), Maxville, 20-V-70, DPJ (2), 5-VI-73, DPW (3,1), 1-III-74, DMH (1,3,11,4,5), 8-III-74, DMH (5), 30-V-75, DPW (2), Whitehouse, 2-VIII-73, DPW & DMH (1,1,2,1,2,1); *Escambia Co.,* Pensacola Beach, 19-VI-75, DPW & DMH (1), Warrington, 22-VI-75, DPJ (1); *Hernando Co.*, Masaryktown, 17-XI-75, DPW and DMH (1); *Hillsborough Co.*, Lutz, 31-VII-75, WAB & JKP (1), Plant City, Arizona Land and Cattle Co., all JWS & KHS, all pasture, 4-II-71 (2), 5-II-71 (6), 20-IV-72 (3), V-72 (1,3,1,3,2,1,3,1,2,3); *Jefferson Co.*, Capps, 8-XI-74, DMH & JKP (2,8), Monticello, 9-II-72, DPW (13), Jct. US-19 & I-10, 5 mi S of Monticello, 26-VII-73, DMH & JKP (4), 16 mi N of Monticello, at wayside park at Georgia border, 19-XI-75, DPW & DMH (2); *Leon Co.*, Lafayette, Southwood Plantation, 12-IX-74, DPW, pasture (1,1,1,1); 9-X-74, DPW, pasture (4 from abandoned mound; 1,6,1,4), 5-VIII-76, WAB, pasture (23), 31-VIII-76, WAB, pasture (4), Tallahassee, 26-VII-73, DMH & JKP (1,1,1), Tallahassee, Tall Timbers Res. Station, 1-III-73, DPW, lawn (7 from abandoned mound; 6); *Marion Co.*, Reddick, 1-II-74, DMH & JKP (2); *Orange Co.*, Orlando, 6-V-71, JWS & KHS (1); *Polk Co.*, Winter Haven, 15-X-75, WAB & JKP (2); *Sarasota Co.*, Myakka River State Park, DPW & DMH, grassy field (1); *Seminole Co.*, Roadside park at Jct. of SR-46 & St. Johns River, 11-IX-75, DPW & DMH, grassy field (1); *Sumter Co.*, Jct. of I-75 & SR-478, 16-I-76, DPW & JKP (1), Wildwood, 8-I-74, DMH & JKP (1); *Union Co.*, Lake Butler, 28-XI-73, DMH (1,1); *Wakulla Co.*, Newport, 9-XII-75, DPW (2). Georgia: *Colquitt Co.*, Hartsfield, 11-VII-72, DPW, pasture (3,1,3,1,4,1,2), 12-VII-72, DPW, pasture (1 collected as larvae, 2 collected as pupae), 19-VIII-72, DPW, pasture (1 collected as larvae; 1,7,2); *Lowndes Co.*, Valdosta, 6-V-71, DPW & JKP (3); *Mitchell Co.*, Sale City, 11-VII-72, DPW, pasture (1), 12-VII-72, DPW, pasture (1,1,1), 28-VIII-72, DPW, pasture (1); *Muscogee Co.*, Columbus, 1-VII-73, DPW & WAB (4); *Sumter Co.*, Plains, 11-IX-75, JKP & CTA (1); *Thomas Co.*, Coolidge, 12-VII-72, DPW, pasture (1 teneral, 1 collected as larvae, 2 collected as pupae; 1,1), 12-VII-72, WAB, pasture (1 collected as larvae); *Tift Co.*, Tifton, 18-XII-70, DPW (3 collected from abandoned mound; 17,21,8,36,17), 6-V-71, DPW, pasture (3 collected as larvae); *Turner Co.*, Ashburn, 22-IV-71, DPW, lawn (1 collected as larvae), 26-IV-72, DPW & JWS, pasture (15,1,2,3,1, 8), Coverdale, 22-VI-71, DPW, pasture (1 collected as larvae; 1), 26-IV-72, DPW & JWS, pasture (10), Sycamore, 22-VI-71, DPW, pasture (1), 26-IV-72, DPW & JWS, pasture (2,1,2,2); *Worth Co.*, Sylvester, 21-VII-72, DPW, pasture (1 collected as larvae; 1) 31-VIII-72, DPW, pasture (1). Louisiana: *Ascension Par.*, Gonzales, 5-XII-75, DPW (2); *Assumption Par.*, Belle Rose, 5-XII-75, DPW (1); *Concordia Par.*, 29-VI-73, DPW & WAB (3,7); *Evangeline Par.*, Chicot State Park, 29-VI-73, DPW & WAB (9); *Rapides Par.*, Alexandria, 29-VI-73, WAB & DPW (6); *St. Charles Par.*, Paradis, 4-XII-75, DPW (2); *St. James Par.*, Union, 5-XII-75, DPW (2); *Tangipahoa Par.*, Hammond, 4-XII-75, DPW (1), 6-XII-75, DPW (3); *Vernon Par.*, Leesville, 28-VI-73, DPW & WAB (6,1). Mississippi: *Claiborne Co.*, Port Gibson, 29-VI-73, WAB & DPW (2); *George Co.*, Lucedale, 7-XII-75, DPW (2); *Harrison Co.*, Lyman, 6-XII-75, DPW (1); *Jackson Co.*, Escatawpa, 7-XII-75, DPW (1); *Lauderdale Co.*, Lauderdale, 21-X-75, DPW & DMH (1), Marion, 21-X-75, DPW & DMH (1); *Pearl River Co.*, Poplarville, 6-XII-75, DPW (1). Texas: *Brazos Co.*, College Station, all JWS, 27-I-75 (6); 26-II-75 (12,18), 10-VI-75 (3,3), 19-VI-75 (16), 29-VIII-75 (4), 31-XII-75 (2), 9-I-76 (6), 18-I-76 (3), Millican, 9-VI-75, JWS (1); *Grimes Co.*, Anderson, 28-II-75, JWS (1); *Polk Co.*, Alabama and Coushatta Indian Reservation, 28-VI-73, DPW & WAB (1); *Walker Co.*, Huntsville, 28-VI-73, DPW & WAB (6).

Myrmecaphodius excavaticollis was collected from 38 nests of *S. richteri*, the black imported fire ant, in AL and MS.—Alabama: *Lamar Co.*, Sulligent, 30-VI-73, WAB & DPW (1), 10 mi N of Sulligent on SR-17, 4-X-73, DMH & JKP (3,20,2,17,21), Vernon, 30-VI-73, WAB & DPW (15,22), 23-X-75, DPW & DMH (5,1); *Marion Co.*, SR-129 to Glen Alan, 30-VI-73, DPW & WAB (4), Winfield, 23-X-75, DPW & DMH (14,7); *Pickens Co.*, Cochrane, 1-IV-76, DPW & JKP (4), Aliceville, 1-IV-76, DPW & JKP (19); *Walker Co.*, Carbon Hill, 23-X-75, DPW & DMH (2). Mississippi: *Chicasaw Co.*, 1/2 mi S of mile post 224 on Natchez Trace Hwy., 22-X-75, DPW & DMH (1), Houston, 22-X-75, DPW & DMH (2); *Choctaw Co.*, Fentress, 29-VI-73, DPW & WAB (1,6); *Lee Co.*, 1 mi N of Nettleton on US-45, 22-X-75, DPW & DMH (2,3); *Noxubee Co.*, Brooksville, 23-X-75, DPW & DMH, pasture (1,8,2,14,4,1,6), 1-IV-76, DPW & JKP (21,41,9,15,4,3,4); *Oktibbeha Co.*, Mississippi State, 29-VI-73, WAB & DPW (1,11).

Myrmecaphodius excavaticollis was collected from 88 nests of *S. geminata*, the tropical fire ant, in FL and TX.—Florida: *Alachua Co.*, Gainesville, 20-IX-74, DMH & JKP (1,4), Paynes Prairie, along US-441, all DPW & DMH, 12-IX-70 (1), 5-II-71 (19,24,14,42,22), 12-VI-73 (5), 24-IX-74 (31,1,7,1,2,20,1), 1-X-74 (10 in abandoned mound; 18,3,4,2,8,7,4,2,6), 16-X-74 (2 & 1 in abandoned mounds; 24,4,58), 30-X-74 (1 & 1 in abandoned mounds; 7,1,14,1,2,3,1,3,1,5,1), 22-XI-74 (2,1,3,1,2,1,3,1,3,2,3,5,1), 3-XII-74 (2,4,8,1,3,5,3,1), 22-IV-75 (2), 6-VI-75 (2,3,2,1,2,4,1,4), 23-III-76, DMH & JDA (6,5,6), 24-III-76, DPJ, DMH & JDA (9,41,19,55), 3-IV-76, DPJ & JDA (3,1). TEXAS: *Brazos Co.*, Bryan, 3-IV-75, JWS (1), 15-III-76 (1), College Station, 23-II-75, JWS (11), Texas A & M Farm, 17-III-75, JWS (26, 7). See additional records in discussion of *M. excavaticollis* and *E. castanea* collected from the same nest.

Myrmecaphodius excavaticollis was collected from 4 nests of *S. xyloni* McCook, the southern fire ant, in GA and TX.—GEORGIA: *Morgan Co.*, 4 mi S of Madison at Jct. of I-20 & US-441, 9-X-75, DPW & DMH (3); *Oconee Co.*, on SR-15, 2 mi N of Co. line, 29-VI-76, DPW (4). TEXAS: *Brazos Co.*, 30-VII-73, JWS (1), College Station, 27-I-74, JWS (1). See additional records in discussion of *M. excavaticollis* and *E. castanea* collected from the same mound.

Myrmecaphodius excavaticollis was collected from 2 nests of *Iridomyrmex humilis* (Mayr), the Argentine ant, in AL and LA.—ALABAMA: *Pickens Co.*, Gordo, 21-X-75, DPW & DMH (1). LOUISIANA: *St. Charles Par.*, Paradis, 4-XII-75, DPW (1).

Euparia castanea was collected from 50 nests of *S. geminata* in FL and GA; all older records of this beetle species must be critically evaluated because of displacement of its native ant hosts by the imported fire ants (discussed later in this paper).—FLORIDA: *Alachua Co.*, Archer, 15-IV-74, DPW & DMH (1,15,1), Gainesville, 3-I-72, DPW (1), Micanopy, 1-XI-73, DPW & DMH (11,11), 29-IV-75, DPW & DMH (8); *Bradford Co.*, Starke, 1-VI-73, DPW (1), 3.2 mi N of Starke on US-301, 12-II-71, DPW (16), 26-II-71, DPW (1); *Clay Co.*, Penny Farms, 4-V-72, DPW (2); *Levy Co.*, Bronson, 3-X-75, DPW & DMH (2); *Marion Co.*, Belleview, 8-I-74, DMH & JKP (8,25,40), 1-II-74, DPW & DMH (3,1,51), 6-III-74, DPW & DMH (6,18,14,6,4), 26-III-74, DPW & DMH (1,15), 9-IV-75, DPW & DMH (1,87,8,2,24,7,2,11,10,1,2,5,1,5,9,8,2,11); *Osceola Co.*, Yee Haw Jct., 6-V-73, WAB (1). GEORGIA: *Jenkins Co.*, Magnolia Springs State Pk., 8-X-75, DPW & DMH (2); *McDuffie Co.*, Jct. I-20 & SR-150, 9-X-75, DPW & DMH (3); *Screven Co.*, Sylvania, 8-X-75, DPW & DMH (2,1,16). See additional records in discussion of *M. excavaticollis* and *E. castanea* collected from the same nest.

Euparia castanea was collected from 14 nests of *S. xyloni,* in GA.—GEORGIA: *Green Co.*, Oconee Natl. Forest, Macedonia Baptist Church, 2-X-73, JKP & DMH (1,2,1), Jct. I-20 & SR-44, DPW & DMH (4,1); *Oconee Co.*, on SR-15, 2 mi N of Co. line, 29-VI-76, DPW (3,25,6); *McDuffie Co.*, Jct. I-20 & US-70, 30-VI-76, DPW (8); *Warren Co.*, Jct. I-20 & SR-223, 9-X-75, DPW & DMH (5,2), Jct. I-20 & Cedar Rocks Rd., 30-VI-76, DPW (2,8,1). See additional records in discussion of *M. excavaticollis* and *E. castanea* collected from the same nest.

Both *M. excavaticollis* and *E. castanea* were collected from the same nests of *S. geminata* 10 times (M=*M. excavaticollis*, E=*E. castanea*), in FL.—FLORIDA: *Alachua Co.*, Gainesville, 15-IV-74, DMH & JKP (18 M, 1 E), 4-III-76, DPJ & DMH (27 M, 1 E), Paynes Prairie, along US-441, all DPW & DMH, 20-IX-74 (14 M, 1 E), 1-X-74 (2 M, 1 E) (1 M, 1 E), (17 M, 1 E), 16-X-74 (1 M, 1 E) (abandoned mound, 1 M, 1 E), 22-XI-74 (1 M, 3 E) 3-XII-74 (15 M, 1 E).

Both species of beetle were also collected twice from the same nest of *S. xyloni,* in GA.—GEORGIA: *Green Co.*, Jct. I-20 & SR-44, 9-X-75, DPW & DMH (1 M, 66 E); *Oconee Co.*, on SR-15, 2 mi N of Co. line, 29-VI-76, DPW (5M, 4E).

DISCUSSION

Myrmecaphodius excavaticollis was apparently introduced from South America with one or both of the 2 species of imported fire ants (Lofgren *et al.* 1975). It is now expanding its range faster than either of its imported hosts and is now found with 5 hosts. It is not known how many species of ants this beetle has as hosts in South America. Several hundred nests of 24 other genera of ants have been examined for myrmecophiles. *Myrmecaphodius excavaticollis* or *E. castanea* were never found in these nests, although other myrmecophiles were collected. No other ants in the Southern United States build large earthen mounds like the *Solenopsis* species. However, *I. humilis,* like the *Solenopsis* species, has very large, populous colonies with large amounts of accessible brood in the soil or under debris. Since both *M. excavaticollis* and *E. castanea* eat ant brood (Wojcik 1975), such large amounts of brood in soil chambers give these beetles easy access to their main food source.

Both species of beetle were collected from abandoned host mounds. These collections often included teneral adults, larvae, and pupae, as well as adults.

Myrmecaphodius excavaticollis already is occasionally very abundant in black light trap collections (Wojcik 1975, Woodruff 1973). This beetle can be expected to become very common in light trap collections in the Southern United States as it increases its range. Thus though detection of *M. excavaticollis* by black light traps was once suggested as a method of survey for imported fire ants (Anonymous 1967), the idea is no longer feasible since *M. excavaticollis* has been collected with both species of native fire ants and from abandoned ant mounds in the Southern United States.

Euparia castanea was never collected from nests of *S. invicta* (1500+ nests floated from 7 states) nor from the nests of *S. richteri* (106 nests floated from 2 states). *M. excavaticollis* can be expected to become more abundant and widespread; and *E. castanea* can be expected to become much less common as *S. invicta* (the more important and widespread imported host) expands its range and eliminates or decreases the populations of *S. geminata* and *S. xyloni* (Whitcomb *et al.* 1972, Roe 1973, Naves 1974).

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The authors thank D. P. Jouvenaz, J. K. Plumley, and K. H. Schroeder of our laboratory, and C. T. Adams, and J. D. Atwood, Department of Entomology and Nematology, Univ. of Florida, for their aid and interest in collecting the beetles. We also thank W. F. Buren, Department of Entomology and Nematology, Univ. of Florida, for his confirmations of our ant identifications and for reviewing the manuscript.

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BOOK REVIEW

The life of beetles, by Glyn Evans. 1975. George Allen & Unwin Ltd. (Hafner Press, A Division of Macmillan Publishing Co., Inc., 860 Third Ave., New York, NY 10022). Hardbound, 232p., $15.95.

Although beetles may account for 25% of all animals, books on beetles account for considerably less than 25% of all books written on animals; in fact, probably less than 1%. Since . . . "We live in an age of beetles, and beetles are almost everywhere." . . . good books on the subject are a welcome addition to the literature. Glyn Evans has written a *very good* book on beetles. It is easy to read, and it is a treasure of information for the amateur (and probably for many professional coleopterists). Among the topics covered are morphology, reproduction, metamorphosis, feeding, habits and habitats, and ecology. The chapters on morphology (2), and habits and habitats (5), are especially informative. The latter chapter, for example, contains a most interesting discussion on aquatic adaptations of beetles. Many excellent black and white diagrams supplement the text, and the chapters on morphology and feeding are especially well-illustrated.

The Appendix presents material on pitfall trapping and keys to the beetles most active on the forest floor. Unfortunately for the American reader, the keys are for use in Britain. A short Glossary (4 pages) is followed by 10 pages of "Further Reading" and Bibliography. The literature listed appears to be fairly extensive and applicable. The Index to Genera and Families is fairly adequate—but it does have some omissions.

In spite of a few shortcomings, this volume has many assets. It is crammed with many interesting facts, appropriate literature cited, and helpful diagrams. Although this book has been on the market two years I have not yet seen it listed in American journals. I heartily recommend it to coleopterists in the U.S.A.

—P.P.S.

FIRE ANT MYRMECOPHILES: BREEDING PERIOD AND OVARIOLE NUMBER IN *MYRMECAPHODIUS EXCAVATICOLLIS* (BLANCHARD) AND *EUPARIA CASTANEA* SERVILLE (COLEOPTERA: SCARABAEIDAE)[1]

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Abstract

Dissection of female *Myrmecaphodius excavaticollis* (Blanchard) and *Euparia castanea* Serville from black light collections indicated that both species flew in all stages of ovarian development. Dissection of beetles collected from light traps, ant mounds, pitfall traps, and on top of ant mounds suggested that *M. excavaticollis* may breed continuously during the year. The maximum number of mature eggs found in *M. excavaticollis* was 26, with most specimens containing 12 or fewer. Dissection of *E. castanea* collected from ant mounds and light traps indicated that this species too may breed continuously throughout the year. The maximum number of eggs observed in *E. castanea* was 18. There were 6 ovarioles per ovary in both species.

Determination of breeding periods by dissection of specimens collected over a period of time has been done extensively with Carabidae (Barlow 1970, Luff 1973, Rivard 1964) and with a few Scarabaeidae (Bedford 1975, Gruner 1973, Habeck 1964, Milne 1959). Gruner (1973) grouped dissected *Phyllophaga pleei* Blanchard (Scarabaeidae) into 3 categories: (1) young (oocytes undeveloped), (2) oocytes mature, and (3) oocytes produced (spent).

Ritcher and Baker (1974) surveyed ovariole numbers in 18 species of Aphodiinae (Scarabaeidae) and found that they ranged from 2 to 7 per ovary depending on the species. The ovariole numbers of *Myrmecaphodius excavaticollis* (Blanchard) and *Euparia castanea* Serville have not been reported in the literature and the breeding periods of these widespread myrmecophilous beetles (Wojcik *et al.* 1977) have not been studied.

As part of a larger study of the biology of these beetles, we investigated the breeding periods and ovariole numbers.

Materials and Methods

The breeding periods of *E. castanea* and *M. excavaticollis* were studied by dissecting female beetles that had been preserved in 70% isopropanol.

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[1] This study was part of a Ph.D. Dissertation by the senior author submitted to the University of Florida, Gainesville, FL. Fla. Agr. Exp. Sta. J. Series 6147.

All available *E. castanea* females were dissected, but the numbers were insufficient for a complete evaluation. The dissected *M. excavaticollis* included females from ant mounds, pitfall traps, and Gainesville light trap collections (Wojcik 1975).

Beetles were dissected by removing the abdomen and peeling back the abdominal tergites with fine forceps. Gut tissue was carefully teased away to expose the ovaries. In sufficiently preserved specimens, the ovarioles and eggs were counted, and the ovariole status was evaluated. Ovaries were classified into 3 categories: (1) immature ovaries (no eggs visible), (2) ovaries with visible eggs (gravid), and (3) spent ovaries (eggs produced). *E. castanea* is always reddish-brown in color, but *M. excavaticollis,* depending on age, is bright redbrown to almost black in category 1. The ovaries of the bright red-brown specimens were always very small and undeveloped; the ovarioles were fused together, and no eggs were present. The ovaries of darker specimens were larger. *M. excavaticollis* in category 2 were always black, with large ovaries, containing small to mature eggs. The ovarioles were separated in the later stages of egg development, facilitating ovariole counts. *M. excavaticollis* were always black in category 3 and had large ovaries with the ovarioles separated, but no eggs were present. If adequately preserved, the oviducts were stretched and flacid looking.

RESULTS AND DISCUSSION

Seventeen specimens of *E. castanea* collected from ant mounds in Florida were available for dissection. These had been collected as follows: January (3 specimens), February (2), March (1), April (7), May (1), June (2), and October (1). One beetle collected in March and 1 in May contained fully developed eggs. Only 1 specimen (from October) had no eggs, with the ovaries disintegrated and the median oviduct enlarged. The remaining 14 individuals had their ovarioles fused together with small to medium sized eggs present. Two of 3 specimens of *E. castanea* from September light trap collections had small oviducts with their ovarioles fused together with small to medium sized eggs present. The third specimen contained no eggs or ovarioles with the ovaries resembling large loose bags. The median oviduct was greatly enlarged. The maximum number of eggs observed in this species was 18.

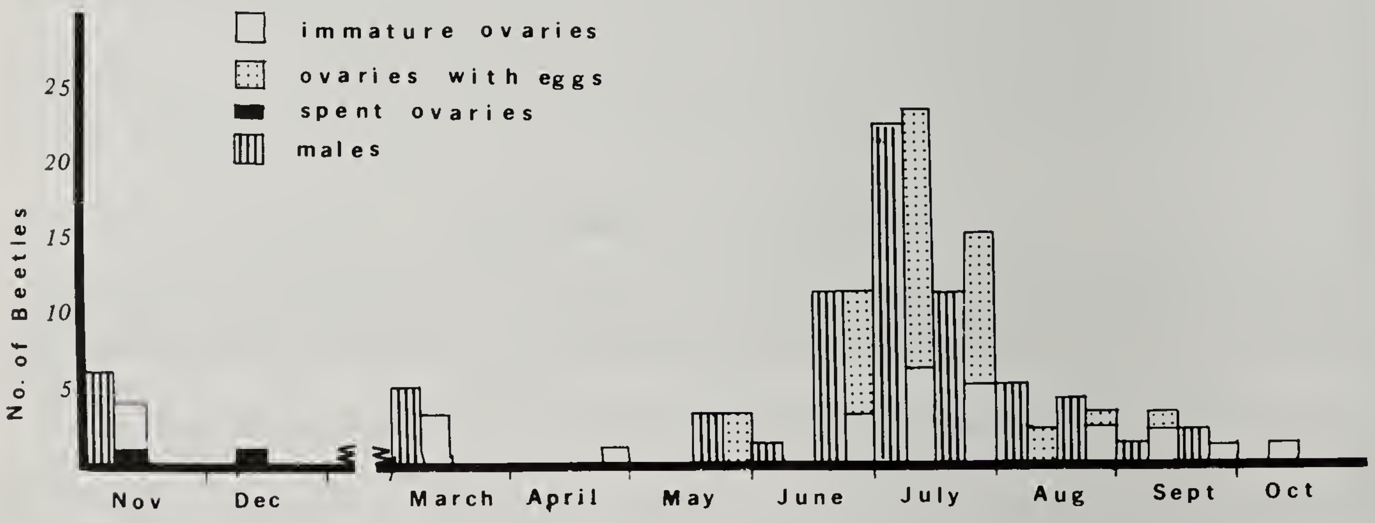

Fig. 1. Numbers of *M. excavaticollis* and reproductive status of females collected in the Gainesville black light trap in semi-monthly intervals.

The results of the dissections of *M. excavaticollis* collected in the Gainesville black light trap are shown in Fig. 1. Beetles with immature ovaries flew year round. Beetles with immature eggs flew from May until September. Two beetles with mature eggs were collected in June and 5 in July. Spent ovaries were found in 1 beetle in November and 1 in December.

Forty-seven beetles that were dissected were collected from ant mounds in Florida as follows: January (8 specimens), February (5), March (3), April (2), May (12), June (10), September (3), and November (4). Of these 47 specimens, 45 were gravid. Thirteen of the gravid specimens contained mature eggs and were collected as follows: February (1 specimen), March (1), May (3), and June (8). One specimen in March and 1 in September contained immature ovaries.

Eight specimens were available from pitfall collections from Georgia and Florida from May (6 specimens), September (1), and November (1). Three of the May specimens contained large mature eggs, and 3 contained smaller immature eggs. The September and November specimens contained immature ovaries.

Seven specimens, collected on top of ant mounds in Florida in July (1) and September (6), were dissected. The July specimen and 2 of the September specimens contained mature eggs. A third September specimen contained immature eggs, and the remaining 3 specimens contained immature ovaries.

The amount of fat body present was not measured, but some general observations were made. Females with large mature eggs usually contained little fat body. Beetles collected from light traps contained much less fat body than those collected from ant mounds, which is in accord with the report of Milne (1959) on the utilization of fat body by *Phyllopertha horticola* (L.). He stated that beetles collected after their initial emergence flight contained less than 50% of their original fat body and had essentially none at the completion of egg deposition.

Other scarabs have been reported to fly during all stages of ovarian development (Bedford 1975, Gruner 1973, Habeck 1964, Milne 1959). All of these reports, however, have to do with plant feeding species, which are usually single brooded. From the status of the ovaries examined in this study, *M. excavaticollis* breeds continuously since gravid beetles were collected from ant mounds and light traps throughout most of the year. (Larvae have been collected from ant mounds during most of the year and are most common in late summer and early fall, Wojcik and Woodruff unpubl.). The adult beetles are apparently long lived. One specimen field-collected as an adult lived 159 days (October to March) in the laboratory (Wojcik and Woodruff unpubl.). Gravid scarab beetles and those with immature ovaries are not usually attracted to black light traps (Habeck 1964); *M. excavaticollis* and *E. castanea* are unusual in this respect.

We were not able to discern corpora lutea in the 2 species studied. Gruner (1973) found corpora lutea in the scarab beetle he studied. If it can be shown that corpora lutea are present, the number of generations per year and the maximum number of eggs produced by each female may be resolved.

The maximum number of mature eggs found in *M. excavaticollis* was 26 (1 specimen). The other beetles examined had 12 or fewer mature eggs. All ovarioles in an ovary apparently do not develop at the same rate. There appeared to be continuous development of eggs, since females were found with ovarioles containing eggs of different sizes.

We made ovariole counts for 3 *E. castanea* and 41 *M. excavaticollis,* and 6 ovarioles were found in each ovary. This contrasts with the 3 ovarioles per ovary in *Ataenius cognatus* (LeConte) and *A. deserta* Horn which were used by Ritcher and Baker (1974) to represent the tribe Eupariini.

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DESCRIPTION OF THE THIRD-STAGE LARVA OF *MEGASOMA ELEPHAS OCCIDENTALIS* BOLIVAR Y PIELTAIN *ET AL.* (SCARABAEIDAE: DYNASTINAE)

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Abstract

The third-stage larva of *Megasoma elephas occidentalis* Bolívar y Pieltain *et al.* is described and illustrated, based on 3 specimens collected near Tecomán, Colima, Mexico. Morphological characteristics are compared with those of the genera *Dynastes* and *Strategus.*

Larvae of American Dynastini are poorly known; only the larvae of *Dynastes tityus* (L.) and *D. granti* Horn have previously been described (Ritcher 1966). Little is known about their biology; they are found in great rotten logs or in deposits of vegetal debris accumulated in the hollows of trees (Glaser 1976).

Technical terms used in this paper are those proposed by Ritcher (1944, 1966).

Dynastine larvae are distinguished from other scarabaeid larvae by the following combination of characters: Mandibles each with a ventral, oval stridulating structure, consisting of transverse granular ridges; maxillary stridulating teeth truncate; lacinia of each maxilla with 3 unci more or less fused at their bases; haptomerum of epipharynx with a raised bilobated or entire ridge or a tooth-like process; distinct zygum and prominent heli absent; epipharynx with both nesia well-developed; both plegmata and proplegmata absent; ocelli usually present; raster usually with no palidia; anal slit transverse and curved (Ritcher 1966: 131). The differential larval characteristics of genera of Dynastini have not been defined; Ritcher (*loc. cit.*) included the North American species in a general key.

This paper includes a description of the third-stage larva of *Megasoma elephas occidentalis* Bolívar y Pieltain *et al.* 1963, and comparison with larvae of *Dynastes* and *Strategus.*

Description

The following description is based on 3 third-stage larvae of *M. e. occidentalis* collected in association with an adult female in MEXICO: State of Colima, Tecomán Municipality, El Saucito, 28-VIII-70, Y. Domínguez & R. Peña, in rotten log of *Cocos nucifera* L., 200 m.

Head. Maximum width of head capsule: 16 mm. Surface of cranium strongly and densely punctate, dark brown to black. Frons on each side bearing 2 posterior frontal setae, 3 median lateral frontal setae, 4 anterior frontal setae, and numerous anterior frontal angular setae of which one is distinctly thicker and longer; the remaining cranial surface bears numerous short, fine, uniformly distributed setae and among them the more conspicuous 2 dorsoepicranial setae and 4 epicranial setae, all placed well away from epicranial suture. Clypeus bearing 4 long setae on preclypeus and numerous short, fine, scattered setae. Labrum subtrapezoidal, with 5 or 6 posterior setae, 2 central setae, 4 lateral setae, and numerous short, fine, scattered setae. Ocelli vestigial (fig. 2-A). Epipharynx (fig. 1-A) with fused zygum and epizygum forming an oblique, sclerotized tubercle; heli absent; right chaetoparia with 52-55 spinelike setae and 56 fine setae; left chaetoparia with 86-90 spinelike setae and few fine setae; right acroparia with 15-17 straight, long, gross setae; left acroparia with 18-20 long, straight, lightly curved, gross setae; acanthoparia with 9 short, curved, spinelike setae. Scissorial area of right mandible with 3 teeth, well-separated by 2 notches; molar area with 3 lobes. Scissorial area of left mandible with 3 well-marked teeth and 1 truncate preincisor tooth; molar area with 2 lobes and a long, truncate acia. Stridulatory area of each mandible well-marked by gross striae (figs. 3-A and B). Galea with conical uncus well-developed; lacinia with 3 conical unci fused at their bases; maxillary stridulatory area with 8 little, subtrapezoidal, truncated teeth and wide, truncate anterior tubercle (fig. 1-B). Labium cylindric in form (fig. 2-B), with numerous long, strong setae located principally at sides; hypopharynx with right anterior lateral process of hypopharyngeal sclerome strongly developed, raised and curved, heavily sclerotized; left hypopharyngeal lateral lobe with an oblique row of 7 posterior lateral setae. Dorsal surface of last antennal segment with 8 sensory spots (fig. 2-C).

Thorax. Pronotum with wide lateral areas, well sclerotized, of reddish color. Mesoprescutum with 1 anterior row of separated short setae and 4 rows of posterior large setae; mesoscutum with 3 lateral rows of long setae; mesoscutellum with 2 rows of long setae; metaprescutum with anterior irregular row of short setae and 3 posterior rows of long setae; metascutum with 4 lateral rows of long setae; metascutellum with 3 rows of long setae. Thoracic spiracles 2.06 mm long and 1.93 mm wide (fig. 3-C). Respiratory plate with indefinite number of irregular-shaped "holes". Lobes of respiratory plate contiguous. Spiracular bulla convex, longitudinal.

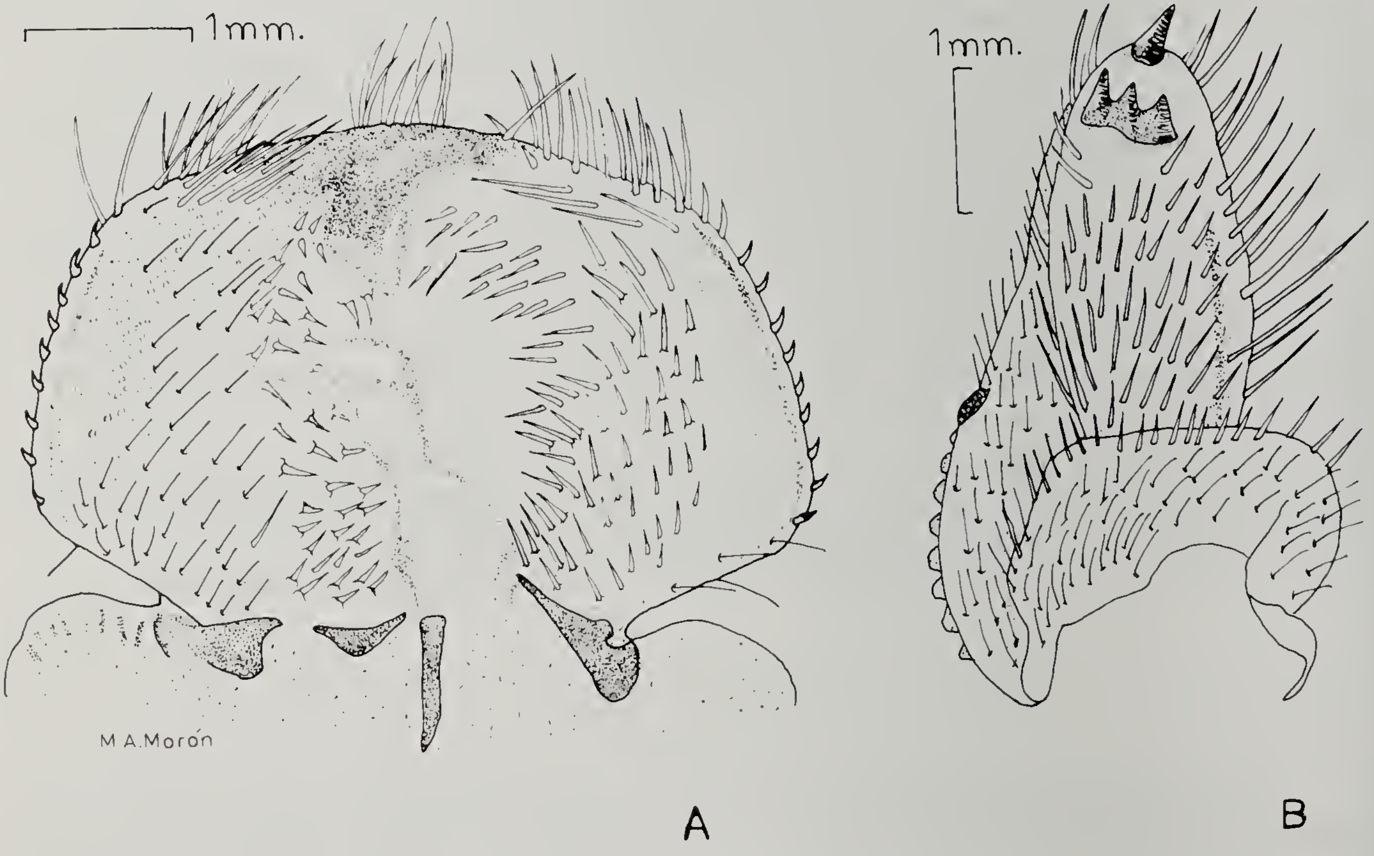

Fig. 1. *Megasoma elephas occidentalis,* third-stage larva. A) Epipharynx. B) Left maxilla, internal view.

Abdomen. Dorsa of segments I-VI each with 3-5 transverse rows of short, spinelike setae; dorsa of segments I-II each with 2-3 transverse rows of long, spinelike setae; dorsa of segments III-VI each with transverse row of long, spinelike setae; dorsum of segment VII with 8-9 transverse rows of short, spinelike setae, 1 anterior row of long, fine setae, 1 anteposterior row of long, fine setae, and 1 posterior row of long, fine setae; dorsum of segment VIII with 7-8 transverse rows of short, spinelike setae, some scattered anterior long, fine setae, 1 anteposterior row of long, fine setae, and 1 posterior row of long, fine setae; dorsum of segment IX with anterior scattered, short, spinelike setae, 1 anterior row of long, fine setae, and 1 posterior row of long, fine setae; dorsum of segment X with scattered short, spinelike setae and long, fine setae (pleural lobes of all abdominal segments densely covered with setae). Venter of abdominal segments I-IX each with 1 median transverse row of long fine setae. Raster (fig. 4-A) with 22-27 long, fine setae in campus; teges with 40-44 scattered, long, fine setae; lower anal lip with 78-86 fine setae; upper anal lip with numerous mixed short, spinelike setae and long, fine setae; setae of barbula sparse. Dorsolateral region of segment X (dorsally adjacent to outer extremity of anal slit) with light, cribrate, subtriangular depression (fig. 4-B). Spiracles of segments I-VIII progressively larger (2 to 3 mm long and 1.8 to 2 mm wide). Claws (fig. 4-C) each bearing 2 internal, long, thick basal setae and 2 external, long thick preapical setae.

Body length. 90-100 mm (figs. 5-6).

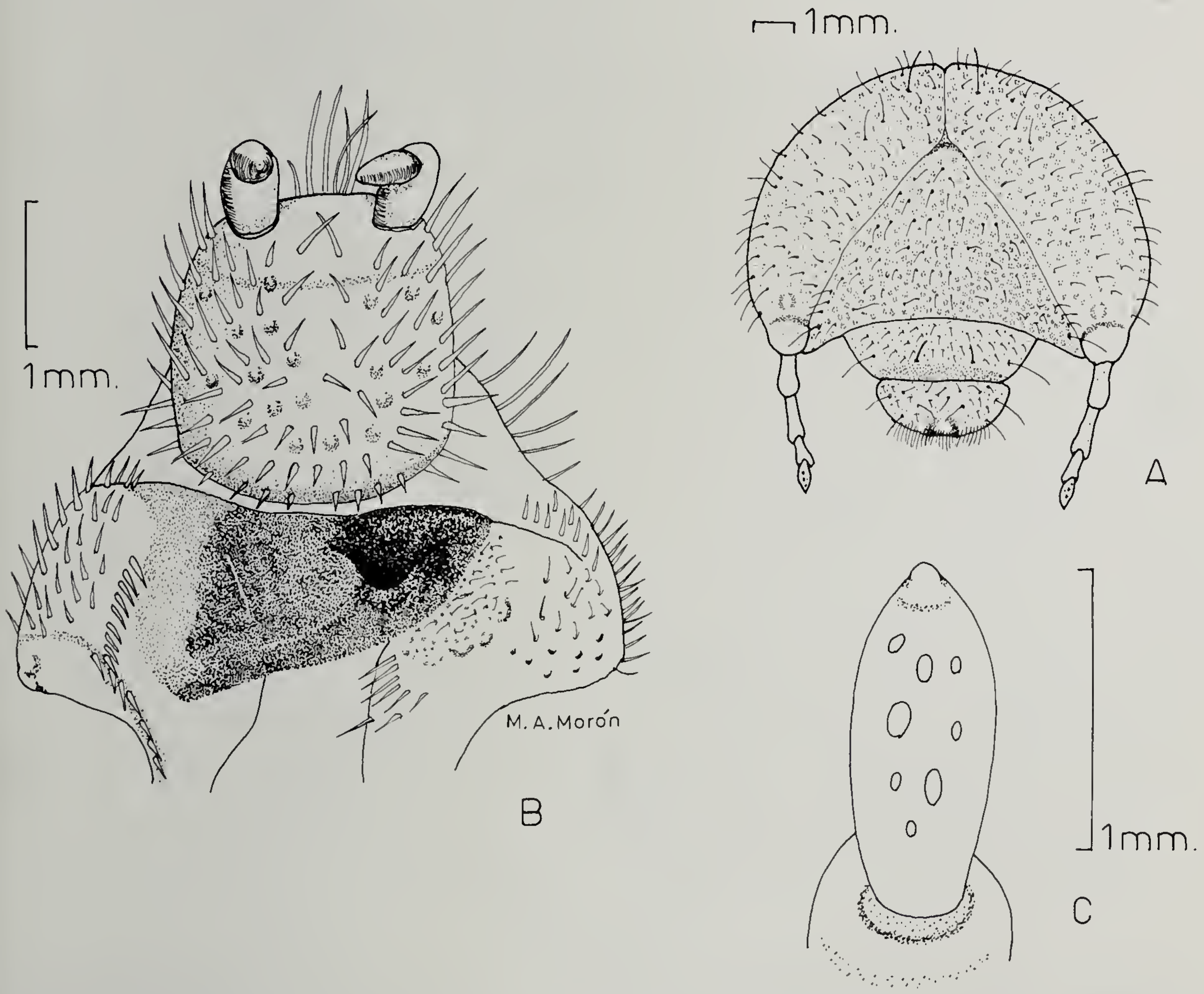

Fig. 2. *Megasoma elephas occidentalis,* third-stage larva. A) Head, frontal view. B) Labium and hypopharyngeal sclerome, internal view. C) Distal segment of antenna, dorsal view.

Distribution

Adults of this subspecies have been collected with electric lights at the following localities. MEXICO. *Colima*: near city of Colima. *Guerrero*: Papanoa; Tecpan; Tierra Colorada; Zihuatanejo. *Jalisco*: Barra de Navidad; Chamela; Puerto Vallarta. *Michoacán*: Coahuayana (type-locality); Playa Azul. *Nayarit*: San Blas. *Sinaloa*: Mazatlán. (Bolívar *et al.* 1963; Hardy 1972).

Discussion

Larvae of *Megasoma elephas occidentalis* are characterized by: 9 spines on acanthoparia; right laterocentral part of anterior border of labrum not sinuous; ocelli vague; anterior abdominal spiracles smaller than posterior spiracles; more than 50 "holes" in respiratory plate; 2-12 rows of setae on abdominal dorsa; setae of barbula sparse; fewer caudal setae; 4 claw setae; and great size and corpulence. These characteristics distinguish larvae of *M. e. occidentalis* from larvae of *Dynastes tityus* and *D. granti.*

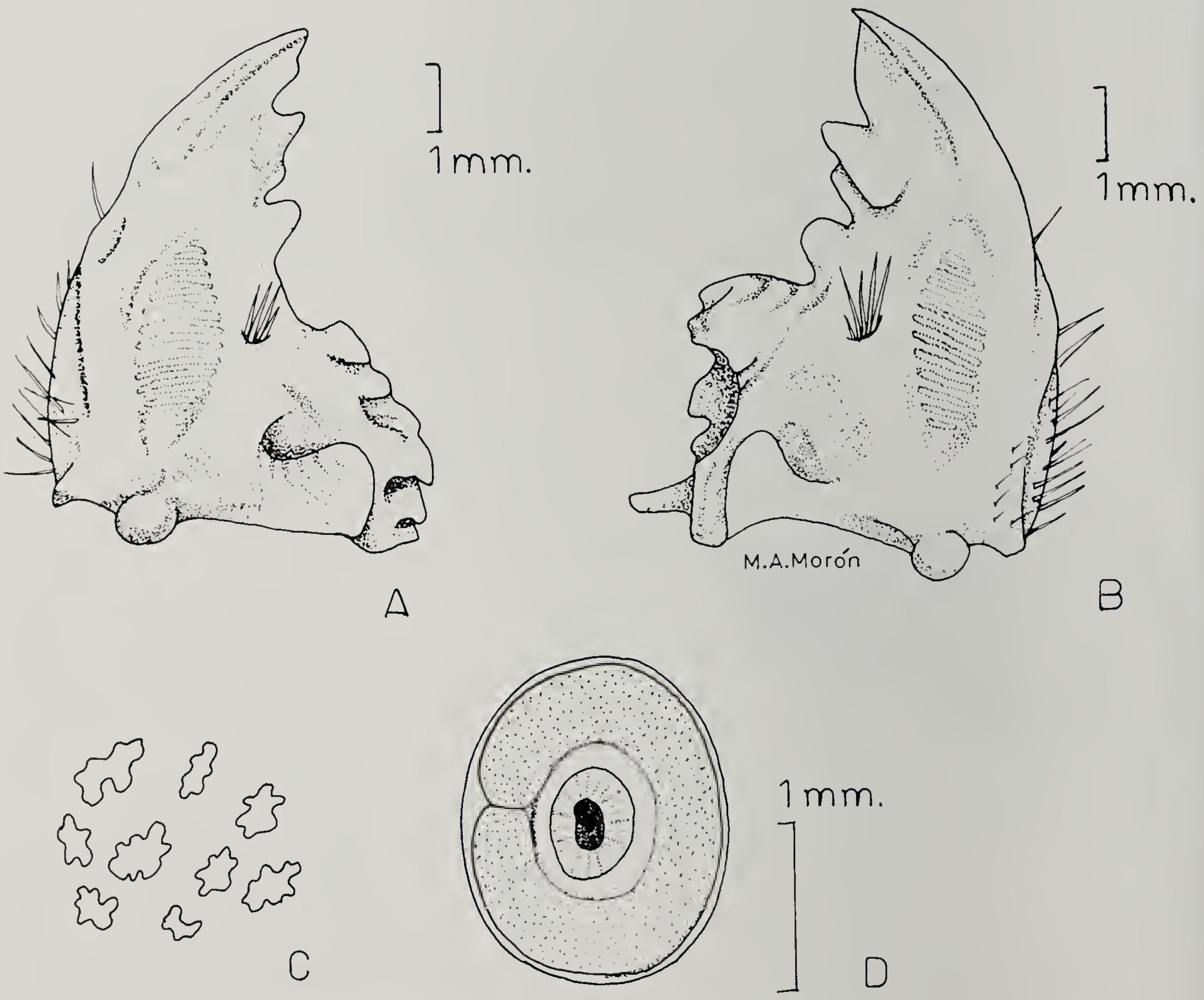

Fig. 3. *Megasoma elephas occidentalis,* third-stage larva. A) Right mandible, ventral view. B) Left mandible, ventral view. C) Structure of respiratory plate of thoracic spiracle (highly magnified). D) Thoracic spiracle.

Characteristics of third-stage larvae of *Strategus* (Dynastinae, Oryctini) and *Megasoma* are compared in Table 1. Larval *Megasoma* differ by: labrum subtrapezoidal; 9 spines on acanthoparia; acia truncate; bulla longitudinal; and lobes of respiratory plate contiguous.

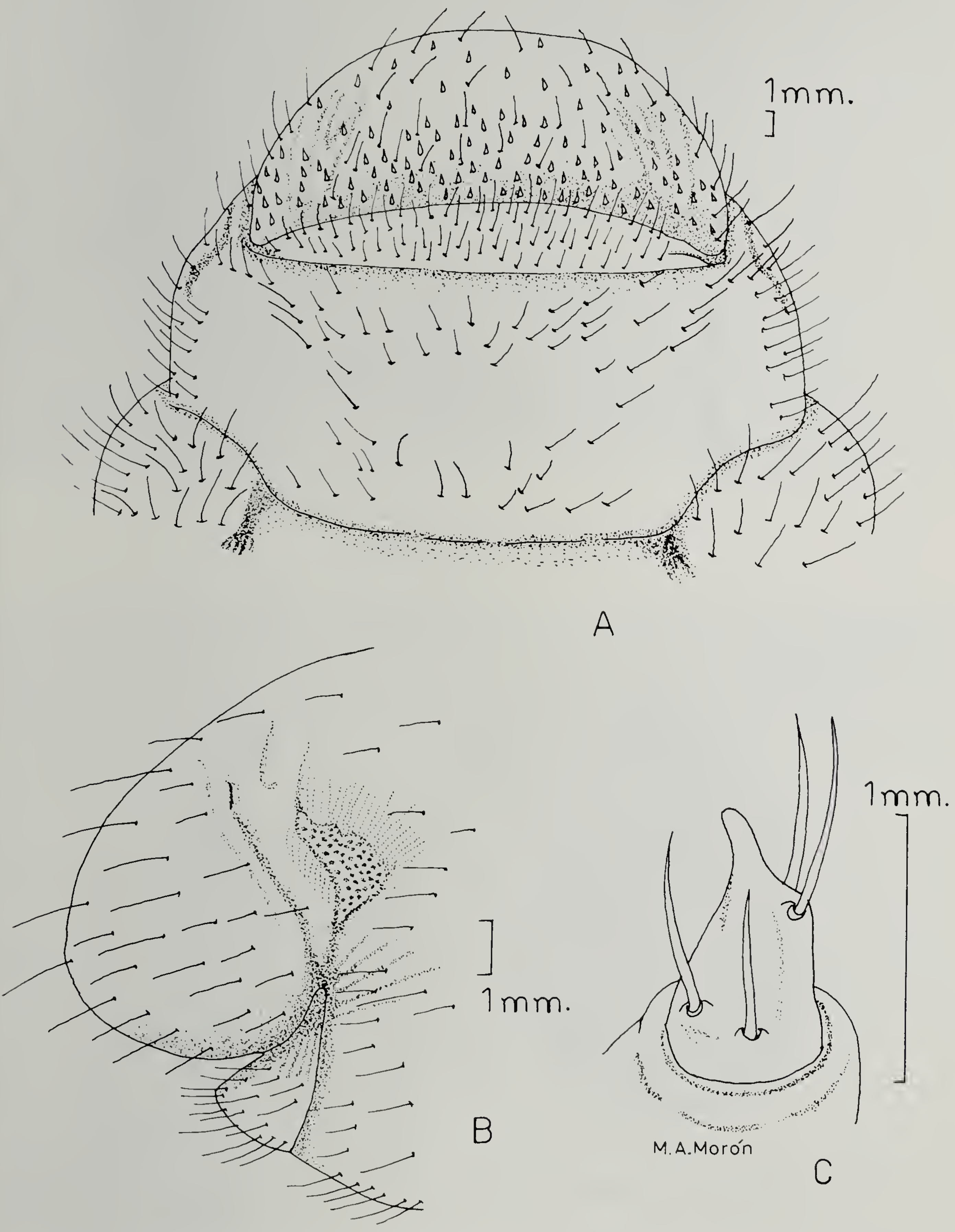

Fig. 4. *Megasoma elephas occidentalis,* third-stage larva. A) Venter of tenth abdominal segment. B) Last abdominal segments, lateral view. C) Claw of left prothoracic leg, side view.

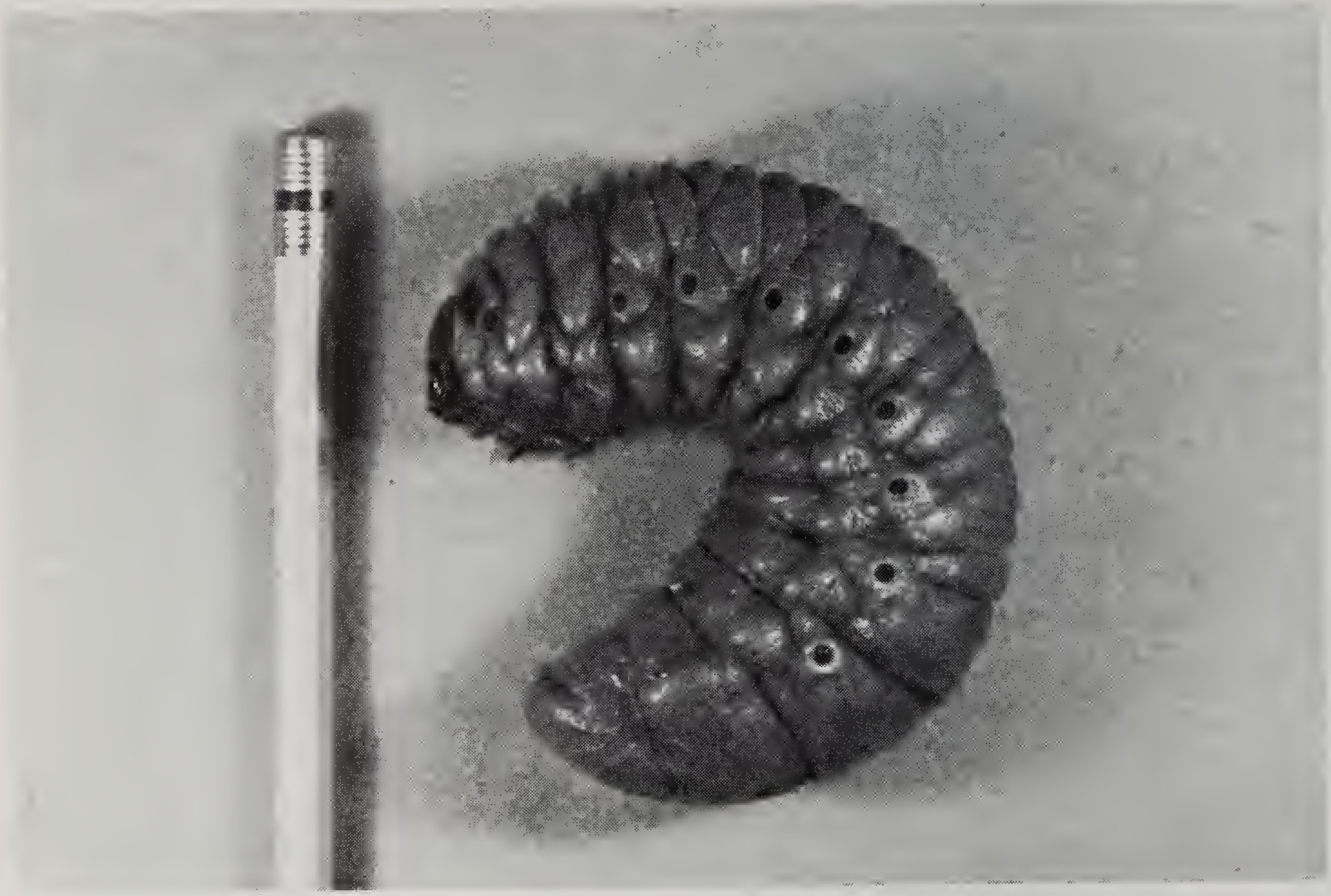

Fig. 5. *Megasoma elephas occidentalis,* third-stage larva, lateral view.

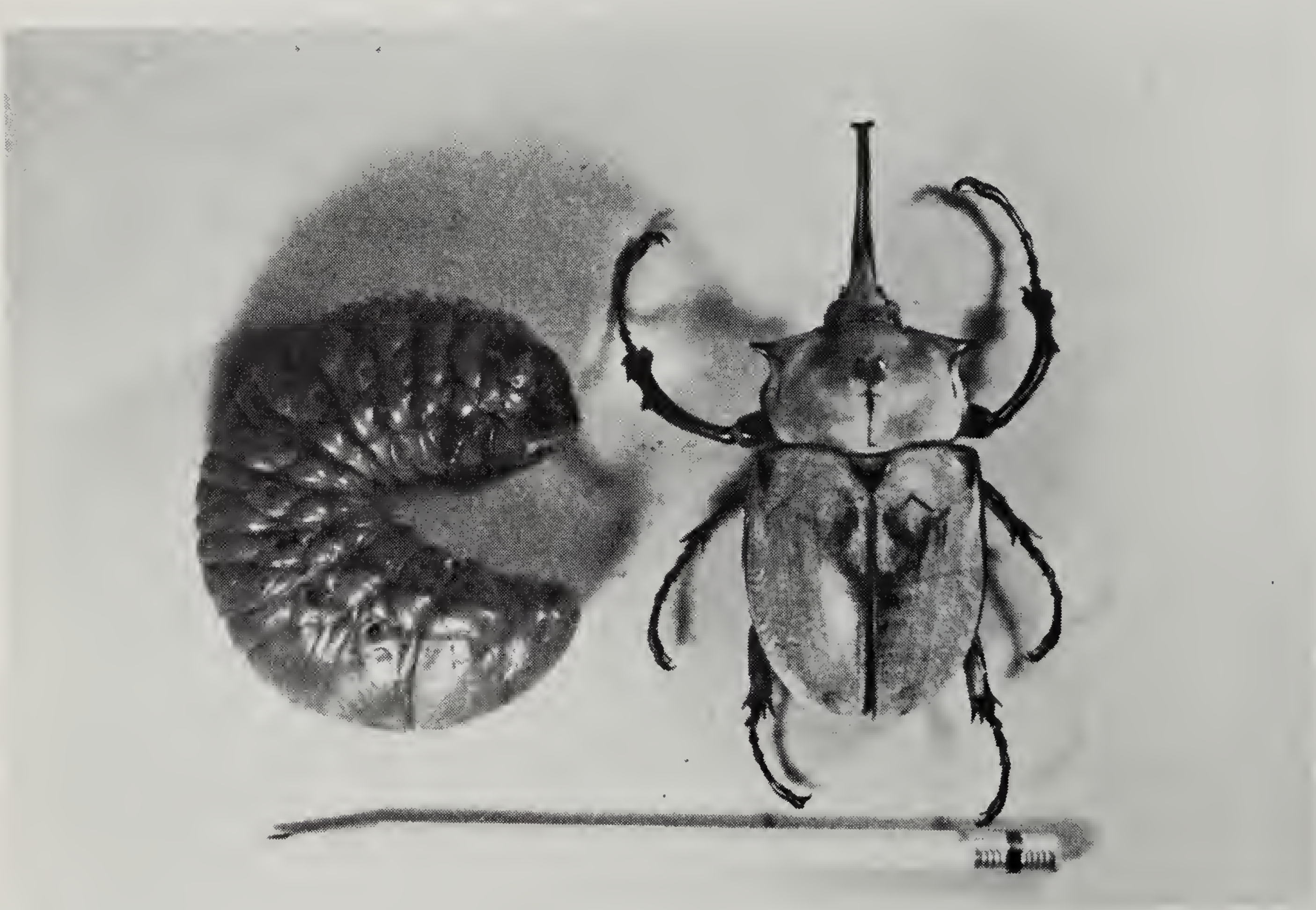

Fig. 6. *Megasoma elephas occidentalis,* third-stage larva, left; major adult male, right.

TABLE 1: Characteristics of third-stage larvae of *Megasoma* and *Strategus*.

Characteristic	*Megasoma*	*Strategus*
Number of dorsal sensorial spots on last antennal segment.	8	6-14
Ocelli.	vague	vague
Shape of "holes" of respiratory plate.	irregular	irregular
Number of claw setae.	4	3-4
Labral form.	subtrapezoidal	rounded
Spines on acanthoparia.	9	13-15
Acia.	truncate	acute
Bulla.	longitudinal	transverse
Lobes of respiratory plate.	contiguous	separated

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I wish to thank Miss Yolanda Domínguez and Mrs. Rebeca Peña (Laboratorio de Entomología, Instituto Nacional de Investigaciones Agrícolas, S.A.G. Chapingo, México) for the loan of larval specimens; I also wish to thank Mr. Roberto Johansen (Departamento de Zoología, Instituto de Biología, U.N.A.M. México) for helpful criticism of the manuscript.

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NOTE ON A FLIGHT BY MALES OF *SCAPTOLENUS OCHRAETUS* HORN

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Observations of flights by *Scaptolenus* spp. (Coleoptera:Cebrionidae) have been rare. Werner (1969) reported on flights by *S. fuscipennis* Fall and *S. mouffleti* Chev., but otherwise the literature is meager. On September 26, 1976 while collecting in Lake Corpus Christi State Park, San Patricio, Co., Texas, we were fortunate to observe a mass flight by *S. ochraetus* Horn. Our evening collecting activities were interrupted approximately one half hour after full darkness by the onset of a thunderstorm. Rainfall totaling 1.49 inches (as measured at the nearby Sinton recording station) fell during the next hour and a half. Toward the end of this period we discovered numerous males of *S. ochraetus* crawling about on the ground under standing lights in the park. In the course of the succeeding hour 143 specimens were collected. Flight began while rainfall was still heavy and continued well beyond the storm's termination. A brief search failed to yield any females in the area.

Our observations are quite similar to those reported by Werner. Apparently flights by *Scaptolenus* spp. males during and immediately after the occurrence of heavy rains are widespread phenomena. Knowledge of this fact should facilitate the collection of species hitherto rare in collections.

Our thanks go to Dr. E. C. Becker, Biosystematics Research Institute, Ottawa, Canada for identification of the specimens and to the Texas Parks and Wildlife Department for permission to collect in Lake Corpus Christi State Park.

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—Paul P. Shubeck

LECTOTYPE DESIGNATIONS AND TAXONOMIC REMARKS ON SOME XANTHOLININE GENERA AND SPECIES FROM CENTRAL AND SOUTH AMERICA (COLEOPTERA: STAPHYLINIDAE)[x]

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Abstract

The type material of several xantholinine species from Central and South America was studied. The genus *Saurohypnus* Sharp 1885, with type-species *S. scutellaris* Sharp 1885, is placed in synonymy with *Thyreocephalus* Guérin-Méneville 1844. The New World species of the genus *Oligolinus auct. (nec* Casey 1906) are reassigned to *Neoxantholinus* Cameron 1944. Lectotypes are designated for *Diochus nanus* Erichson 1839, *Homalolinus canaliculatus* (Erichson 1839), *Thyreocephalus scutellaris* (Sharp 1885), *T. puncticeps* Sharp 1885, *T. rufipennis* Sharp 1885, *Neoxantholinus guatemalensis* (Sharp 1885), and *N. lineatus* (Schubert 1909). *Thyreocephalus halffteri* (Mexico) is described as new, and a key to Mexican species related to *T. rufipennis* is given.

Recently, I studied the original material of some Central and South American Xantholininae. None of these species was known to occur north of Mexico, but I needed to compare them with some species included in my revision of Xantholininae of America north of Mexico (in preparation). The results of this study, including lectotype designations, are presented here.

The original specimens from the Sharp collection were made available to me by P. M. Hammond, British Museum (Natural History), London, and those from the Erichson collection by M. Uhlig, Museum für Naturkunde der Humboldt-Universität zu Berlin, German Democratic Republic. Their assistance is gratefully acknowledged.

I also wish to thank my colleagues, E. C. Becker, D. E. Bright, and J. M. Campbell, in the Coleoptera Unit of the Biosystematics Research Institute, for their suggestions and criticisms of the manuscript.

Diochus nanus Erichson

Diochus nanus Erichson 1839:301, pl. 1, fig. 6

The Erichson collection in the Museum für Naturkunde der Humboldt-Universität zu Berlin contains 2 conspecific specimens under the name *D. nanus.* The first specimen is labelled as follows: "5793"/"nanus Er. Columb. Mor." (large green label). The second specimen is without any labels. Both specimens were dissected and the genital segments with spermathecae were mounted in Canada balsam. The first specimen, bearing the label "5793", is hereby designated as lectotype of *D. nanus*; the label "Lectotype Diochus nanus Erichson A. Smetana des. 1977" was attached to it.

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[x] 108th contribution to the knowledge of Staphylinidae.

One female from a series of 4 specimens in the Canadian National Collection, collected in Brazil ("Brazil, 18 km. NE Oriximina, XI-13, 14-1969, J M & B A Campbell"), matches the lectotype in every detail. The red label "Diochus nanus Er., compared with lectotype, Smetana 1977" was attached to it. One male from the same series, which I believe is conspecific with this female, was dissected and the terminal abdominal segments (including the genital segment) and the aedoeagus were mounted. These parts are illustrated by Figs. 1-4.

D. schaumi Kraatz (1860:27), widely distributed in America north of Mexico, was occasionally considered conspecific with *D. nanus* (e.g. Blackwelder 1943:455). In fact, *D. nanus* and *D. schaumi* are different species, as shown by Figs. 5-8, illustrating the terminal abdominal segments (including the genital segment) and the aedoeagus of one male of *D. schaumi,* which has been compared with the specimens of Kraatz's original series. Even the female spermathecae seem to be different in these 2 species (Figs. 9, 10).

Homalolinus canaliculatus (Erichson)

Xantholinus canaliculatus Erichson 1839:307

The Erichson collection in the Museum für Naturkunde der Humboldt-Universität zu Berlin contains 4 conspecific specimens under the name *X. canaliculatus.* The first specimen is labelled as follows: "5803"/"canaliculatus Dej. Bogota Bug." (large green label). The remaining 3 specimens are without any labels. The first specimen, bearing the label 5803, was dissected, remounted on a plate, and the aedoeagus and the genital segment were mounted. These parts are illustrated by Figs. 11, 12, 24. This specimen is hereby designated as lectotype of *H. canaliculatus*; the label "Lectotype Xantholinus canaliculatus Erichs. A. Smetana des. 1977" was attached to it. Nine segments of the left antenna, 4 segments of the right antenna, middle left tarsus, and middle right leg are missing in this specimen.

Thyreocephalus Guérin-Méneville

Thyreocephalus Guérin-Méneville 1844:10
Saurohypnus Sharp 1885:501 (**new synonymy**)

Adults of the type-species of *Saurohypnus, S. scutellaris* (see below), differ by the relatively small size, the narrow form, and the general habitus from those of the remaining neotropical species of *Thyreocephalus* known to me; however, I was unable to find any characters which would justify its generic separation. The name *Saurohypnus* should be considered a synonym of *Thyreocephalus.*

Thyreocephalus scutellaris (Sharp), **new combination**

Saurohypnus scutellaris Sharp 1885:502

The species was described from specimen(s?) from Pinos Altos in Chihuahua, Mexico. I have seen one specimen (apparently a female) from the collection of the British Museum (Natural History), London, labelled as follows: "Saurohypnus scutellaris Type D.S. Pinos Altos Chihuahua. B.-

Hepburn" (on plate with beetle)/"Type" (round label with red margin)/ "Pinos Altos, Chihuahua, Mexico. Buchanan-Hepburn."/"B.C.A.Col.I.2. Saurohypnus scutellaris, Sharp."/"Sharp Coll.1905.-313." The specimen is hereby designated as lectotype of *S. scutellaris*; the label "Lectotype Saurohypnus scutellaris Sharp A.Smetana des. 1977", and my determination label "Thyreocephalus scutellaris (Shp.)" were attached to it.

One specimen labelled: "Tup"/"Mexico Coll.J.Flohr"/"scutellaris Sharp sec.Fauvel"/"Xantholinus dugesi" in the collection of the Museum für Naturkunde der Humboldt-Universität zu Berlin was compared with the lectotype; the red label "Comp. with lectotype Saurohypnus scutellaris Shp., A.Smetana March 1977" was attached to it.

Thyreocephalus puncticeps Sharp

Thyreocephalus puncticeps Sharp 1885:501

The species was described from 2 specimens from Uruapan and Juquila, Mexico. I had the opportunity to study 1 female specimen from the collection of the British Museum (Natural History), London, labelled as follows: "Thyreocephalus puncticeps Type. D.S.Uruapan.Mexico.Flohr." (on plate with beetle)/"Type" (round label with red margin)/"Uruapan, Mexico.Flohr."/"B.C.A.Col.I,2 Thyreocephalus puncticeps,Sharp."/"Sharp Coll.1905.-313." The specimen (3 apical segments of the left antenna, 2 apical segments of left front tarsus, and right metatarsus are missing) is hereby designated as lectotype of *T. puncticeps*; the label "Lectotype Thyreocephalus puncticeps Sharp A.Smetana des.1977" was attached to it.

Two specimens labelled "Uruapan 13"/"Mexico Coll.J.Flohr" and 1 specimen labelled:"Juquila 15"/"Mexico Coll.J.Flohr" in the collection of the Museum für Naturkunde der Humboldt-Universität zu Berlin were compared with the lectotype. One male from Uruapan was dissected and the aedoeagus and the genital segment were mounted. These parts are illustrated by Figs. 13, 14, 27. The red label "Thyreocephalus puncticeps Shp. compared with lectotype, Smetana 1977" was attached to this specimen.

Thyreocephalus rufipennis Sharp

Thyreocephalus rufipennis Sharp 1885:500

The species was described from 3 specimens from Oaxaca (Mexico) and San Gerónimo (Guatemala). I had the opportunity to study 1 male specimen from the collection of the British Museum (Natural History), labelled as follows: "Thyreocephalus rufipennis.Type.D.S.Oaxaca.Mexico. Hoge."/"Type" (round label with red margin)/"Oaxaca,Mexico.Hoege."/ "B.C.A.I.2.Thyreocephalus rufipennis,Sharp"/"Sharp Coll.1905.-313." The specimen (in perfect condition) was dissected, and the aedoeagus and genital segment were mounted. These parts are illustrated by Figs. 15, 16, 29. The specimen is hereby designated as lectotype of *T. rufipennis*; the label "Lectotype Thyreocephalus rufipennis Sharp A. Smetana des.1977" was attached to it.

Thyreocephalus halffteri Smetana, **new species**

Externally extremely similar to *T. rufipennis*, but different as follows:

size smaller, form narrower. Head smaller and distinctly narrower, as long as wide (in *T. rufipennis* l/w index = 0.92), only feebly rounded laterally, posterior angles broadly rounded, however not forming continuous arc with base of head and lateral margins as in *T. rufipennis*; punctation of head denser, especially laterally and posteriorly; underside of head with more numerous punctures (in *T. rufipennis*, large areas of underside are almost without any punctures). Punctures on lateral portions of pronotum on average more numerous. Microsculpture on abdominal tergites slightly coarser.

Male. Tergite of genital segment of elongate pentagonal shape, apical margin more or less truncate and bearing numerous rather long bristles (Fig. 17). Sternite of genital segment very similar to that of *T. rufipennis* but narrower (Fig. 18). Aedoeagus very similar to that of *T. rufipennis* but smaller and with internal sac differently developed (Figs. 28, 29).

Length 13.0-14.8 mm.

Type material. Holotype (male) and allotype (female): Mexico: "Mex. Tizapan el Alto Edo. de Jalisco, 19.VI.1968 G. Halffter". In the Canadian National Collection, Ottawa, Canada (CNC No. 15355).

Paratypes: same data as holotype, 1 male; "Tepic 30"/"Mexico Coll.J.Flohr"/ "rufipennis Sh.", 1 male; "Mexico Tepic 30 Coll.Flohr", 1 male. In the Canadian National Collection, Ottawa, and in the Museum für Naturkunde der Humboldt-Universität zu Berlin.

Distribution. The species is known from the states of Nayarit and Jalisco in Mexico.

Bionomics. No details are known about the habits of this species.

Discussion. Adults of this species are easily distinguished from those of *T. rufipennis* by the characters given in the description. The length of the lectotype of *T. rufipennis* (with the abdomen slightly extended) is 17.0 mm. It differs from *T. puncticeps* adults, in addition to the differences in the male aedoeagus, by the smaller size and narrower form, and the sparser punctation of the underside of the head.

Etymology: the species is named in honour of Dr. G. Halffter, Museo de Historia Natural de la Ciudad de Mexico, who collected some specimens of the original series.

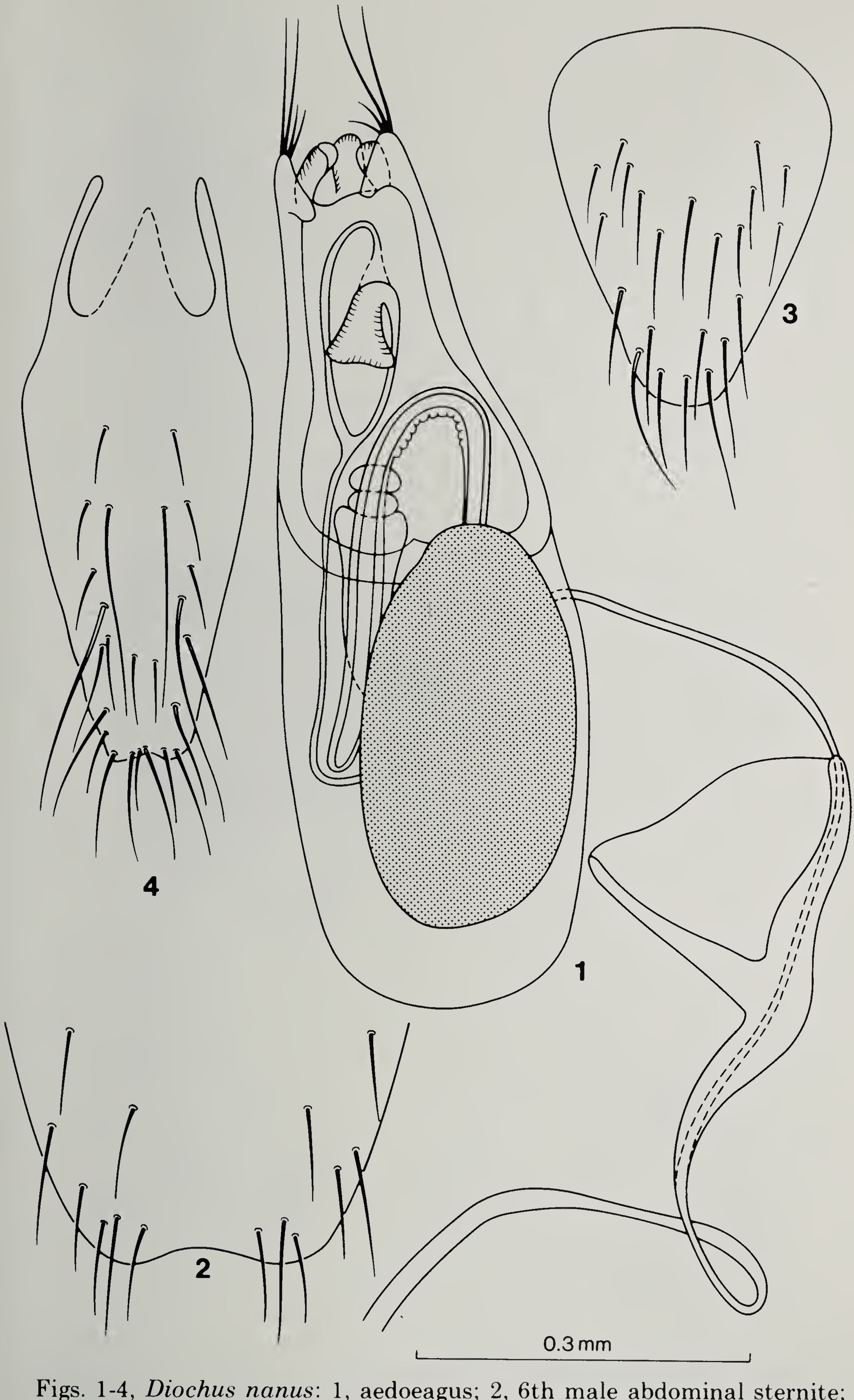
Adults of the 3 Mexican species with red elytra, closely related to *T. rufipennis,* can be distinguished as follows:

1(2). Aedoeagus very large and voluminous (Fig. 27). Underside of head coarsely and densely punctate. Length 15.0-18.0 mm........ .... *T. puncticeps* Sharp

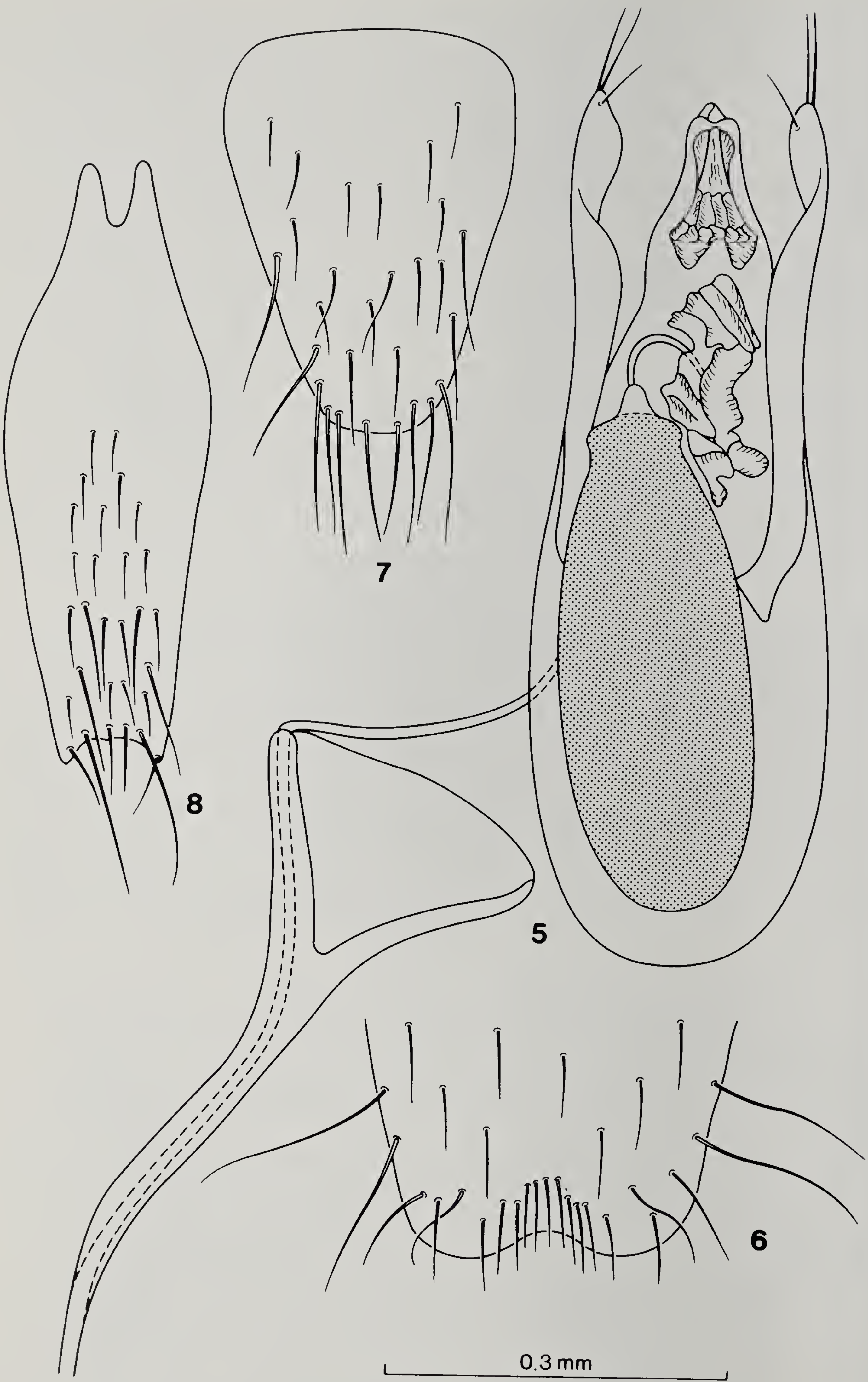
1′. Aedoeagus considerably smaller and not voluminous (Figs. 28, 29). Underside of head less coarsely and sparsely punctate........... 2

2(1′). Aedeoagus as in Fig. 29. Head large and wide, slightly wider than long (l/w index = 0.92); lateral margins rounded, forming continuous arc with base of head, posterior angles therefore completely absent; underside of head very sparsely punctate. Size larger, form stouter. Length 17.0 mm .... *T. rufipennis* Sharp

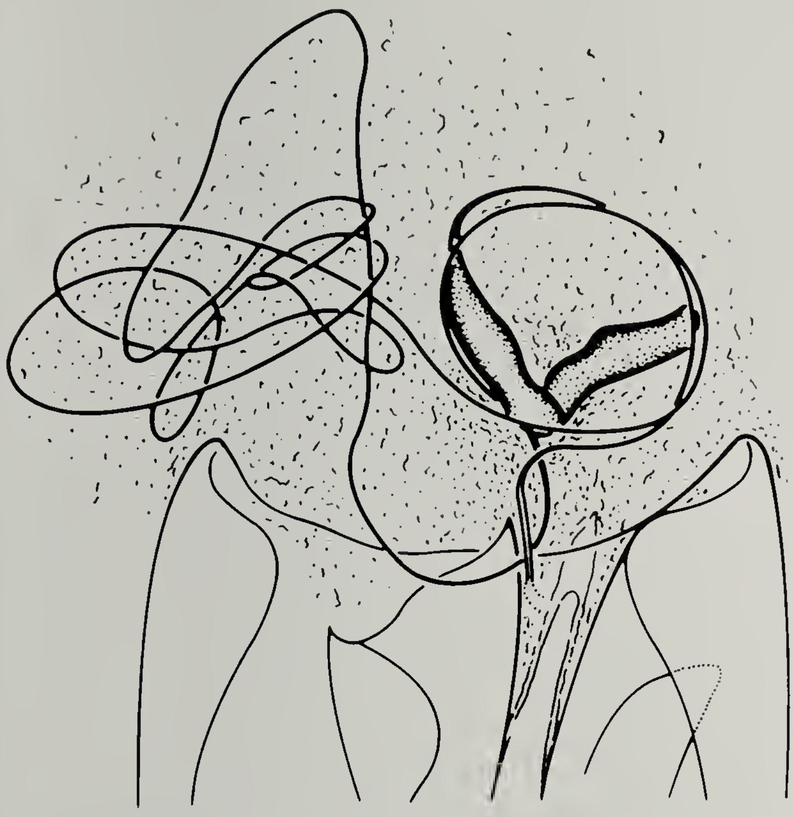
2′. Aedoeagus as in Fig. 28. Head smaller and distinctly narrower, as long as wide; lateral margins feebly rounded, posterior angles broadly rounded, however not forming continuous arc with base of head and lateral margins; underside of head sparsely punctate. Size smaller, form narrower. Length 13.0-14.8 mm .... *T. halffteri* n. sp.



Figs. 1-4, *Diochus nanus*: 1, aedoeagus; 2, 6th male abdominal sternite; 3, tergite of male genital segment; 4, sternite of male genital segment.



Figs. 5-8, *Diochus schaumi*: 5, aedoeagus; 6, 6th male abdominal sternite; 7, tergite of male genital segment; 8, sternite of male genital segment.



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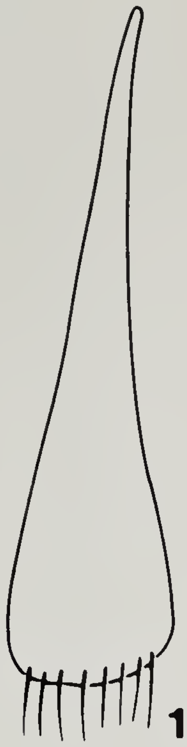

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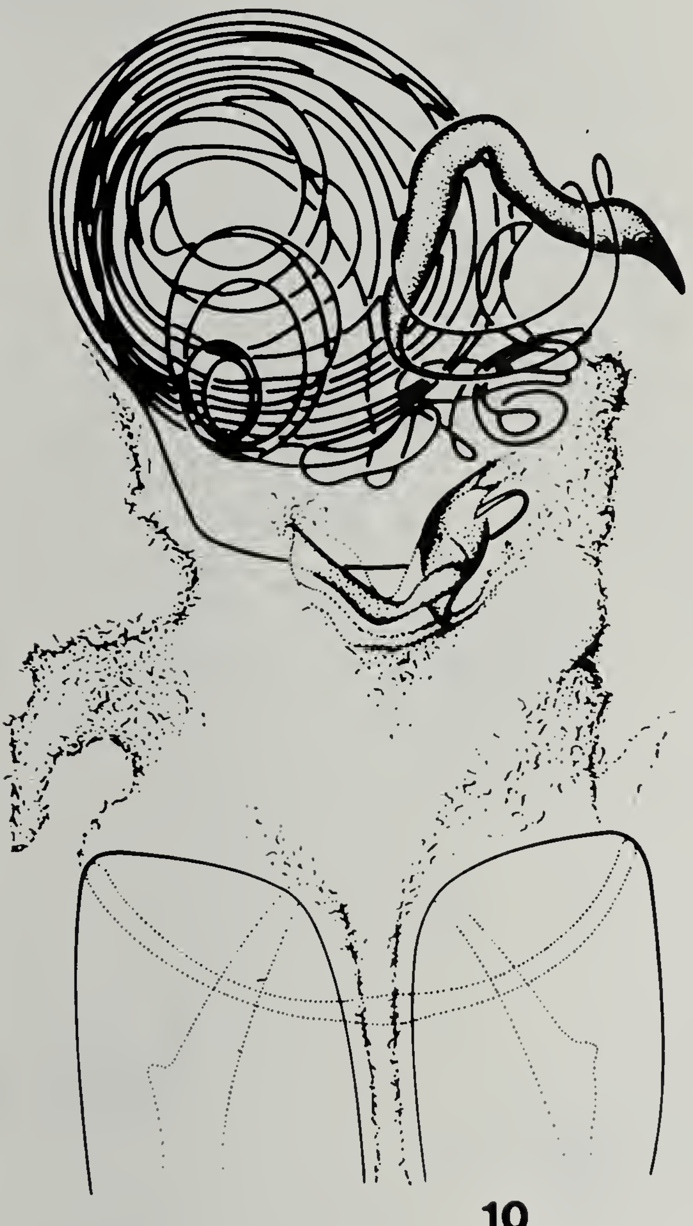

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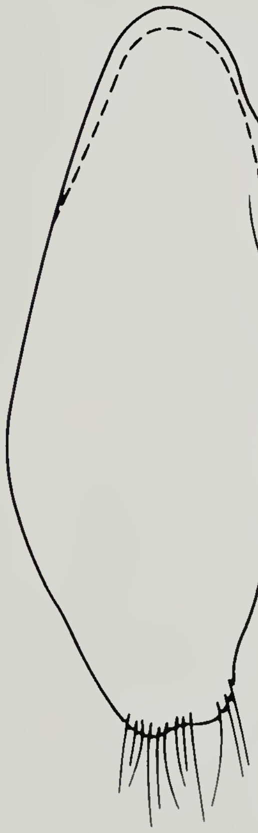

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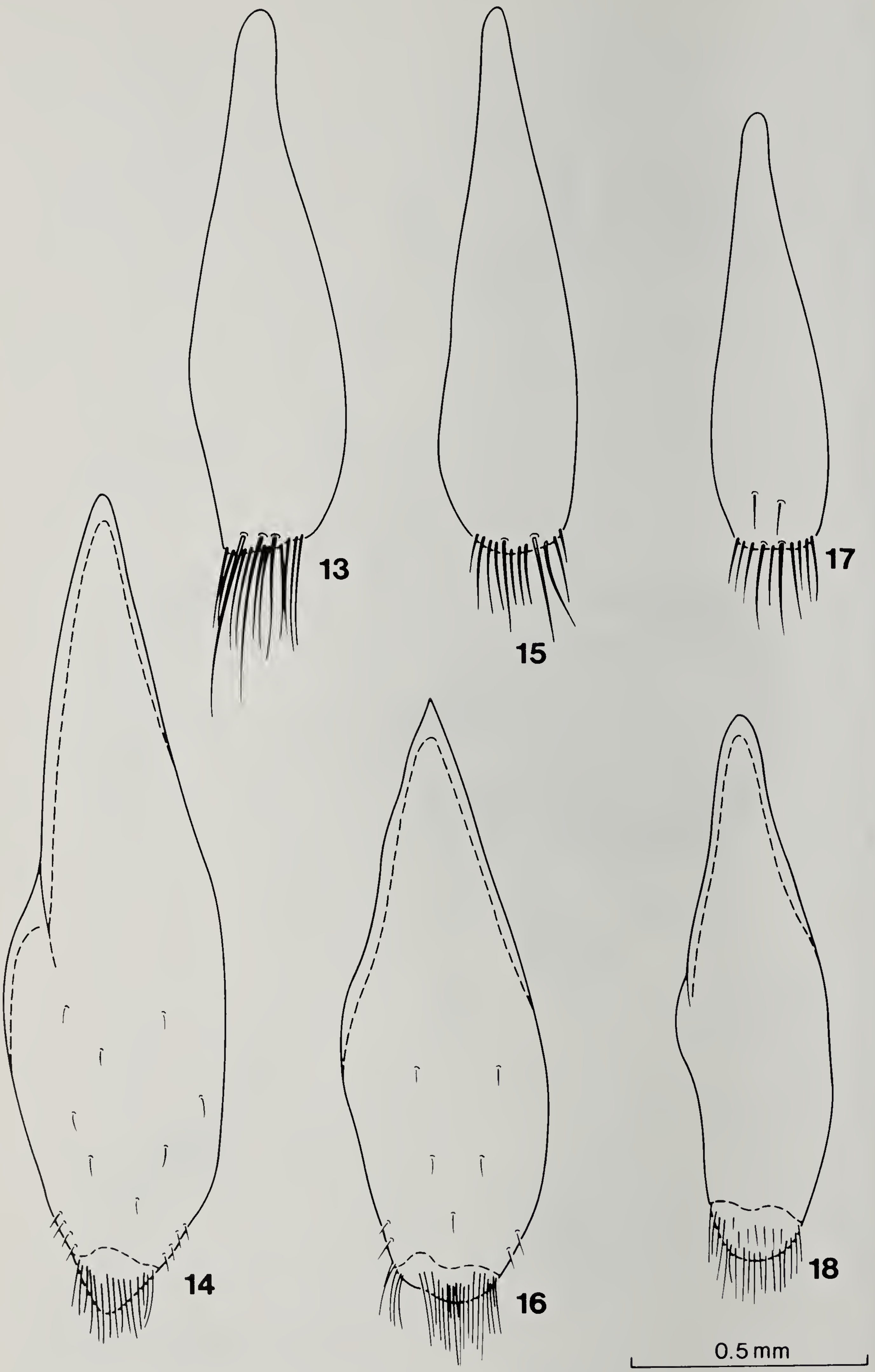
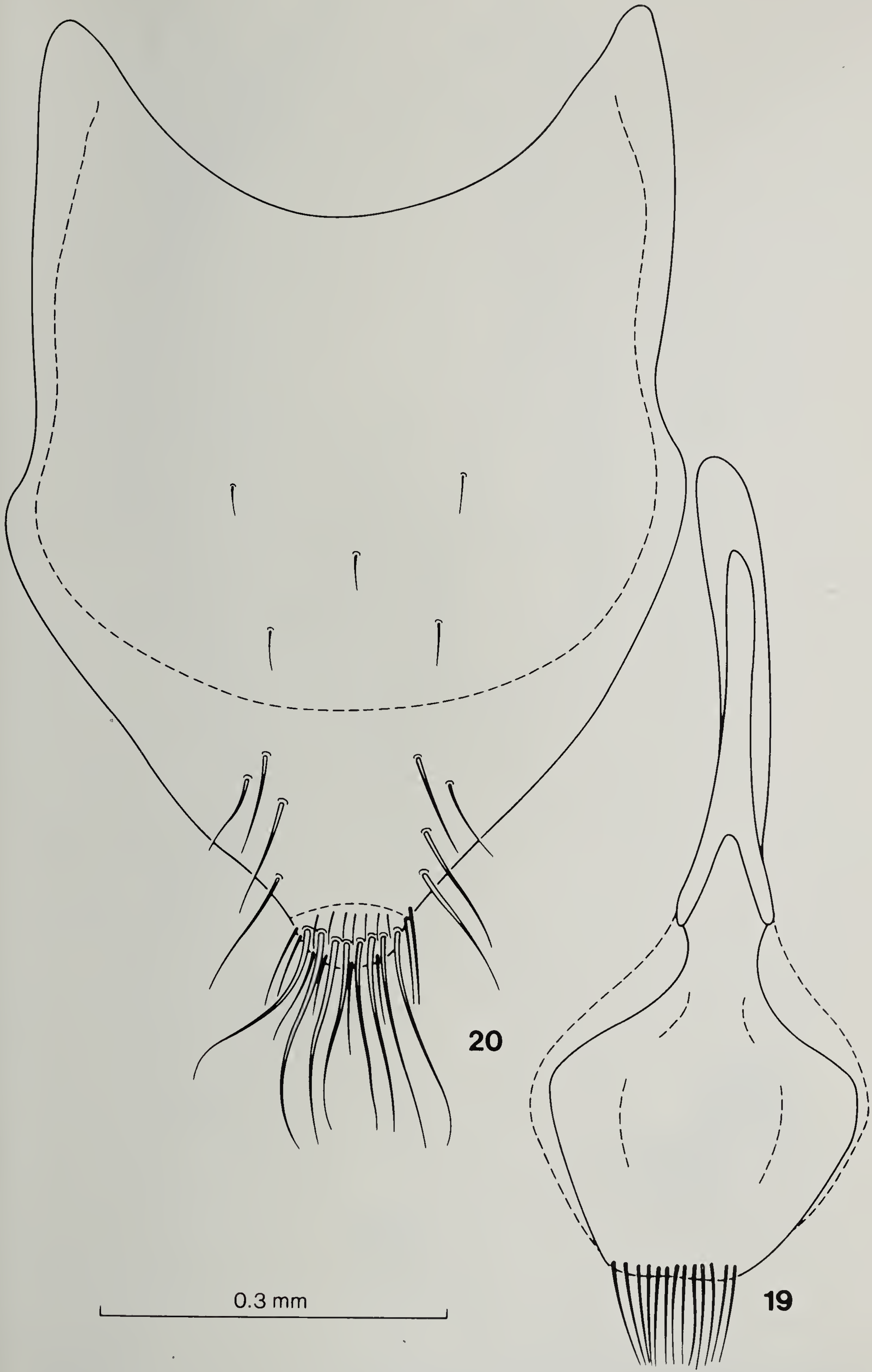
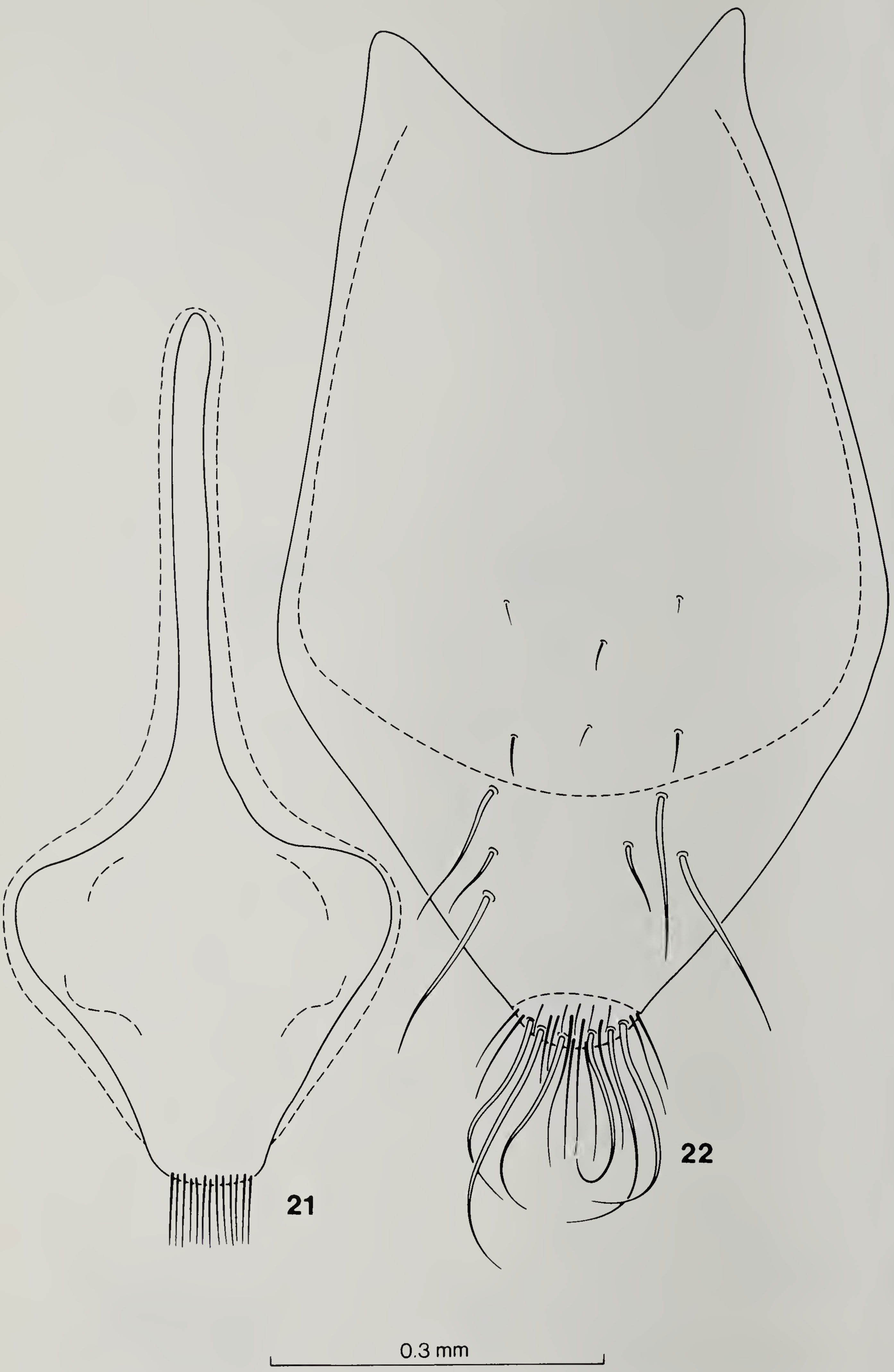
Figs. 9-10, female spermathecae: 9, *Diochus nanus*; 10. *Diochus schaumi*. Figs. 11, 12. *Homalolinus canaliculatus*: 11, tergite of male genital segment; 12, sternite of male genital segment.



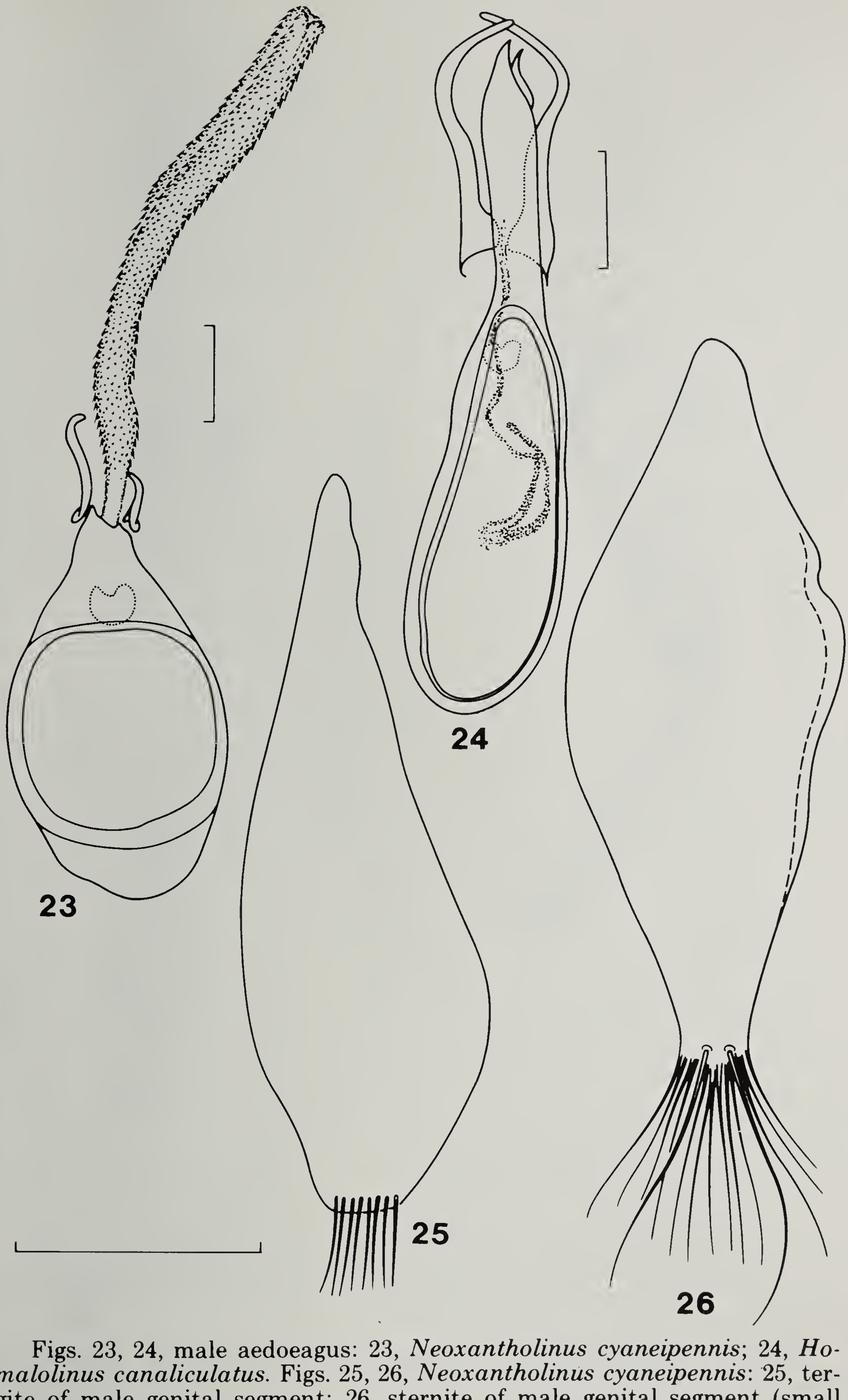
Figs. 13-18, tergites and sternites of male genital segments: 13, 14, *Thyreocephalus puncticeps*; 15, 16, *Thyreocephalus rufipennis*; 17, 18, *Thyreocephalus halffteri*.



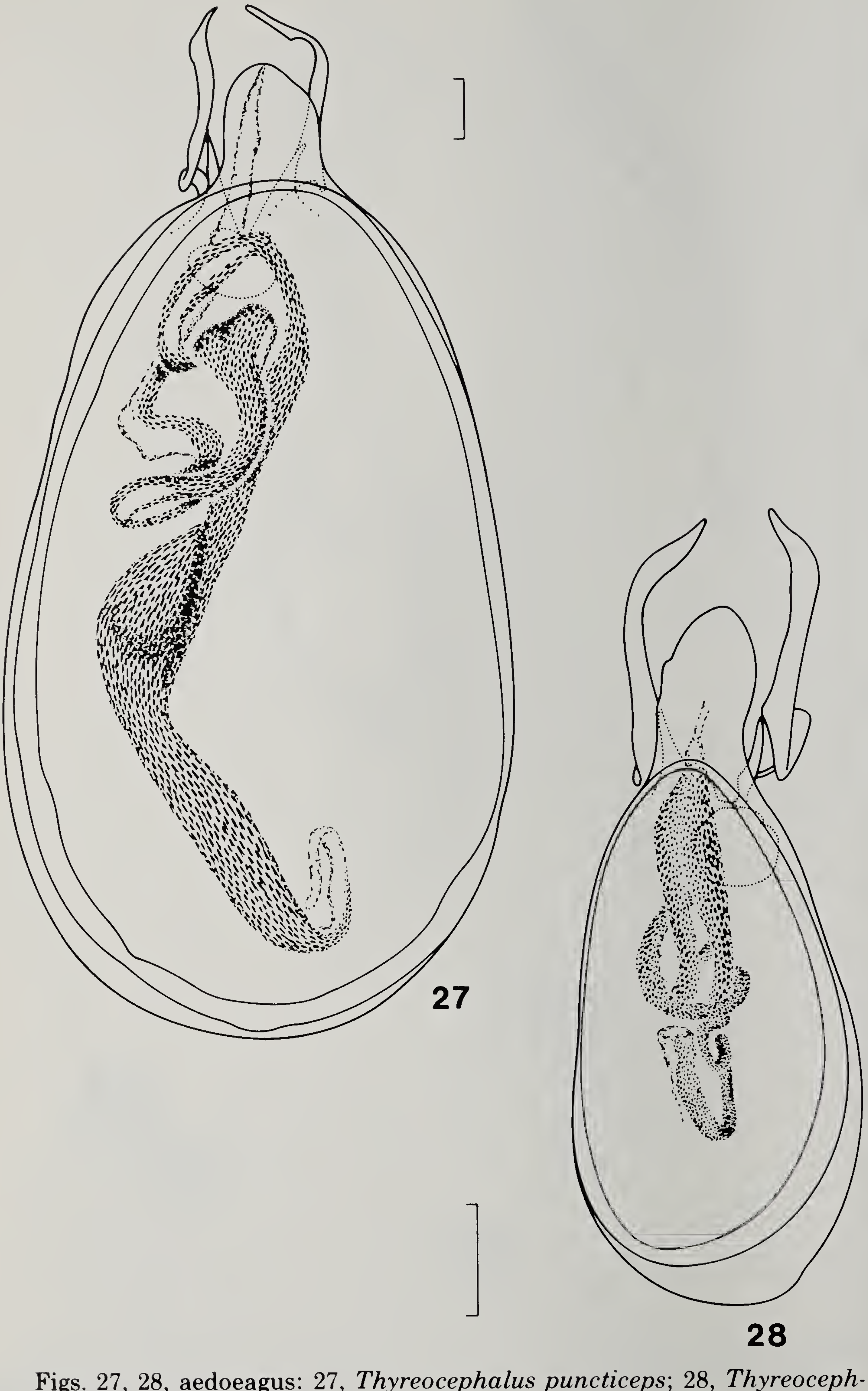
Figs. 19, 20, *Neoxantholinus rufulus*: 19, tergite of male genital segment; 20, sternite of male genital segment.



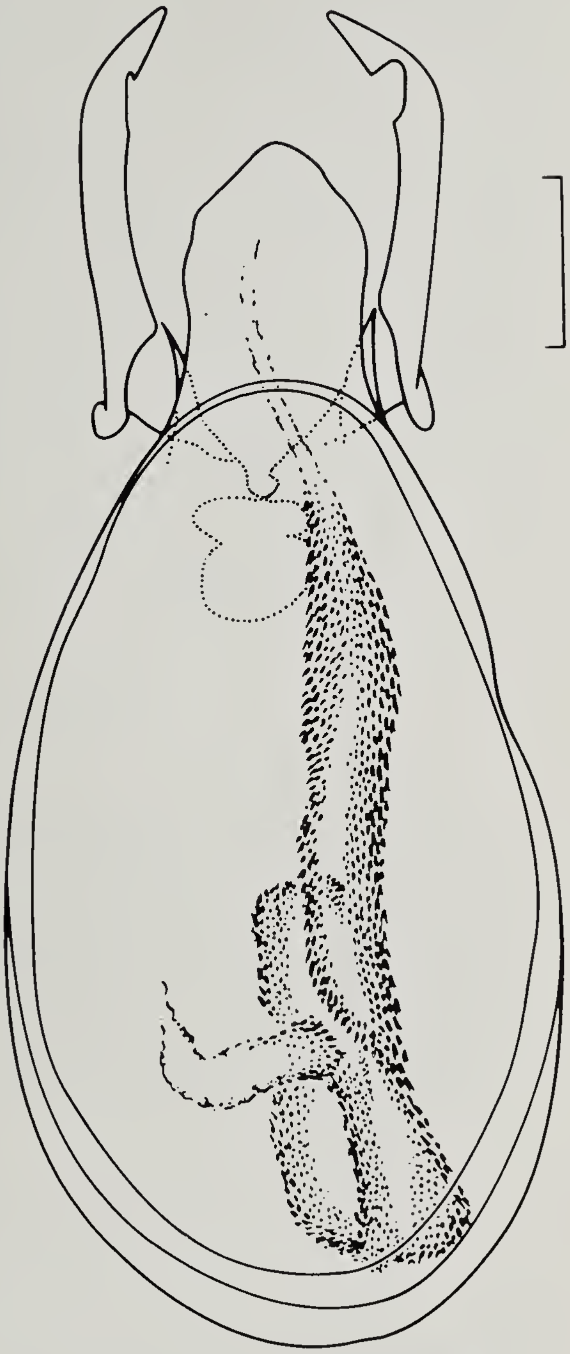
Figs. 21, 22, *Neoxantholinus* spec. (Mexico): 21, tergite of male genital segment; 22, sternite of male genital segment.



Figs. 23, 24, male aedoeagus: 23, *Neoxantholinus cyaneipennis*; 24, *Homalolinus canaliculatus*. Figs. 25, 26, *Neoxantholinus cyaneipennis*: 25, tergite of male genital segment; 26, sternite of male genital segment (small scale = 0.2 mm, large scale = 0.5 mm).



Figs. 27, 28, aedoeagus: 27, *Thyreocephalus puncticeps*; 28, *Thyreocephalus halffteri* (scale = 0.2 mm).



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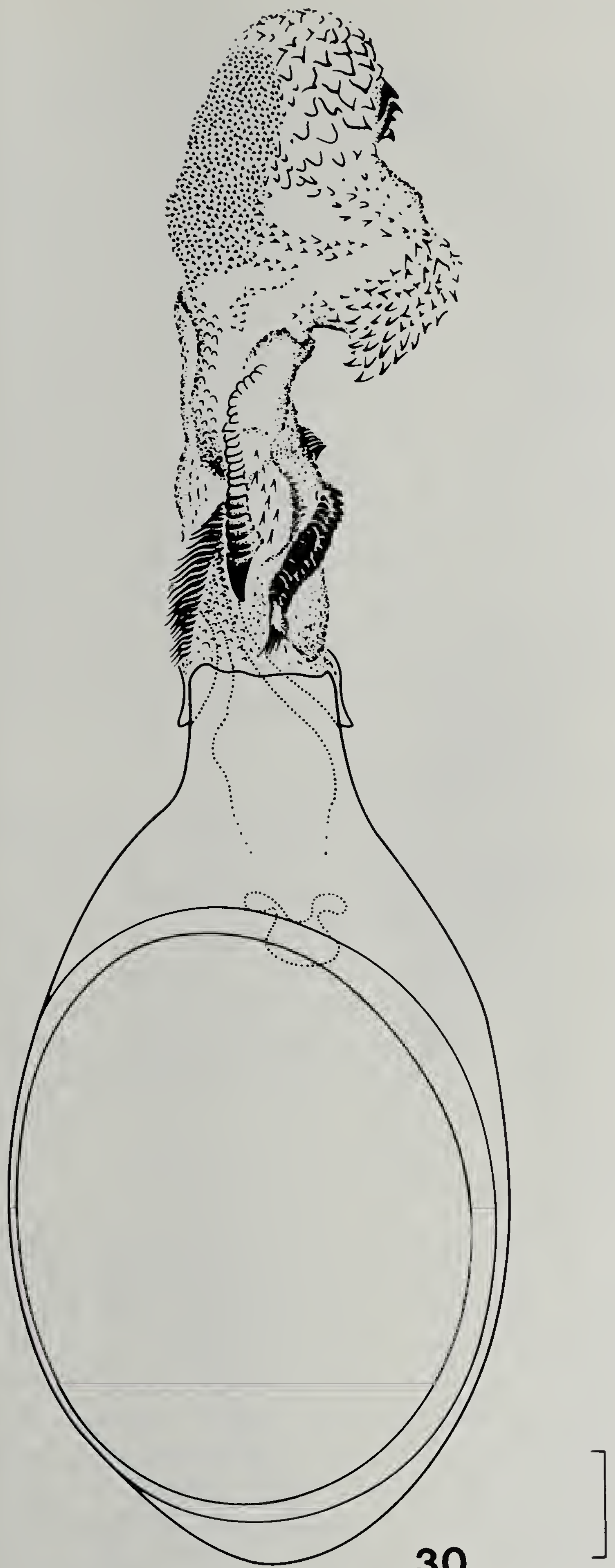

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Figs. 29, 30, aedoeagus: 29, *Thyreocephalus rufipennis*; 30, *Neoxantholinus rufulus* (scale = 0.2 mm).

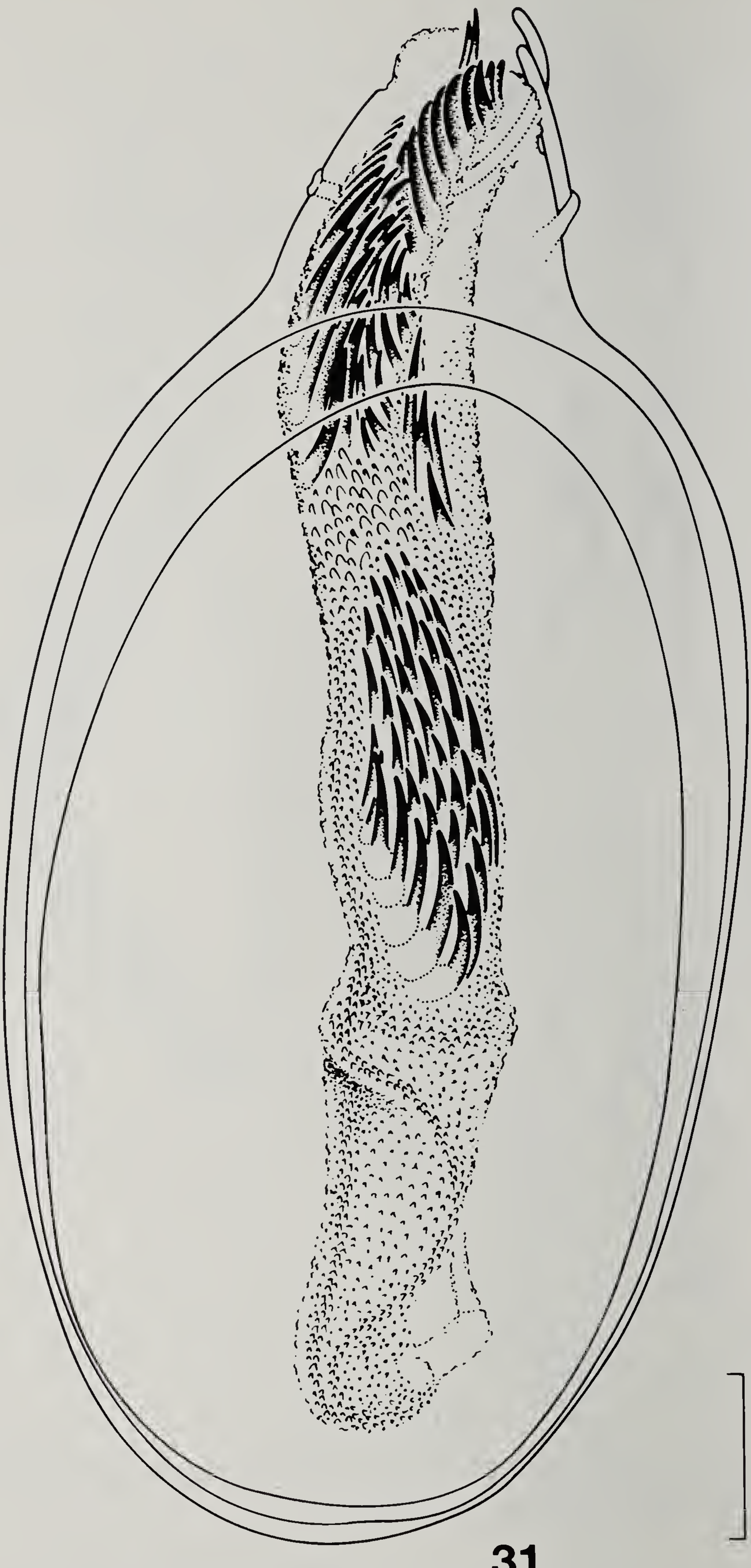

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Fig. 31, aedoeagus of *Neoxantholinus* spec. (Mexico). Scale = 0.2 mm.

Neoxantholinus Cameron

Neoxantholinus Cameron 1944:783

The genus was erected by Cameron (l.c.) to include 2 New Zealand species, *N. rufulus* Broun and *N. brouni* Sharp, previously assigned to the genus *Metoponcus* Kraatz. Steel (1948:268) suggested that the neotropical genus *Oligolinus auct. (nec* Casey 1906:420) was identical with *Neoxantholinus* and that all species listed in this genus by Bernhauer & Schubert (1914:291) belonged in fact to *Neoxantholinus.* He also assigned the Australian *Metoponcus cyaneipennis* Macleay to the same genus. My comparison of the holotype of *N. rufulus* (see below) with adults of one Mexican species of *Oligolinus auct.* (closely related to *O. varians* Sharp) confirmed Steel's opinion. Both species share the same important generic characters, and also the male genital segments and aedoeagi are developed in a very similar way in both species (see Figs. 19-22, 30, 31). On the other hand, *N. cyaneipennis* adults seem to differ in some external characters (e.g. the antennae resemble more those of the palaearctic species of *Metoponcus*), and the male genital segment and the aedoeagus are developed differently (Figs. 23, 25, 26), so that this species may be generically different. To the best of my knowledge, all species included in Scheerpeltz's (1953:604) key to all known species of *Oligolinus auct.* should be reassigned to *Neoxantholinus.*

Neoxantholinus rufulus (Broun)

Metoponcus rufulus Broun 1880:106

The species was described from a single specimen from Parua (see Broun, l.c.). The male holotype in the collection of the British Museum (Natural History), is labelled as follows: "Type" (round label with red margin)/ "New Zealand Broun Coll.Brit.Mus.1922-482"/"Parua.Whangarei."/ "Metoponcus rufulus". The specimen is in very good condition, except the right antenna is lacking 6 segments. It was dissected and the aedeoagus and the genital segment were mounted. These parts are illustrated by Figs. 19, 20, 30.

Neoxantholinus guatemalensis (Sharp)

Metoponcus guatemalensis Sharp 1885:503

The species was described from 2 specimens from San Gerónimo, Guatemala. I had the opportunity to study 1 female specimen from the collection of the British Museum (Natural History), labelled as follows: "Metoponcus guatemalensis.Type.D.S. S.Geronimo.Guat.Champion" (on plate with beetle)/"Type" (round label with red margin)/"San Geronimo, Vera Paz.Champion."/"B.C.A.Col.I.2. Metoponcus guatemalensis,Sharp."/ "Sharp Coll.1905.-313." The specimen was dissected, and the genital segment was glued separately on the plate with the beetle. The specimen is hereby designated as lectotype of *N. guatemalensis*; the label "Lectotype Metoponcus guatemalensis Sharp A.Smetana des.1977", and my determination label "Neoxantholinus guatemalensis (Shp.)" were attached to it.

In this species, the temples are delimited by a fine linear ridge ventrally, and the abdominal tergites are without microsculpture, except for excessively fine and superficial, hardly detectable rudimentary microsculpture on laterobasal portions of the first visible tergite.

Neoxantholinus lineatus (Schubert)

Metoponcus lineatus Schubert 1909:296

The species was described from specimen(s?) from Jalapa, Mexico (Schubert 1909:287). The collection of the Museum für Naturkunde der Humboldt-Universität zu Berlin contains 1 female specimen under the name *M. lineatus*. It is labelled as follows: "Metoponcus lineatus m.sp.type."/ "Jalapa Mexico F.Schneider"/"lineatus m." (large green label). The specimen was dissected, and the genital segment was glued separately on the plate with the beetle. The specimen is hereby designated as lectotype of *N. lineatus*; the label "Lectotype Metoponcus lineatus Schub. A.Smetana des. 1977" and my determination label "Neoxantholinus lineatus (Schub.)" were attached to it. The left middle leg and right elytron are missing in this specimen.

Adults of this species are very similar to those of *N. guatemalensis,* but the temples are not delimited by a linear ridge ventrally, and the abdominal tergites are covered with distinct microsculpture of very fine transverse waves.

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NEW *MECYNOTARSUS* WITH A KEY TO THE NEW WORLD SPECIES (COLEOPTERA: ANTHICIDAE)

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ABSTRACT

Relationships among the New World members of *Mecynotarsus* are discussed, and a key to the New World species is included. The *candidus*- and *schenklingi*-groups are designated and defined. The *candidus*-group contains *M. candidus* LeConte and *M. delicatulus* Horn. The *schenklingi*-group contains *M. schenklingi* Pic. Three new species are added to Werner's *elegans*-group: *M. alvarado* from Veracruz, Mexico; *M. vafer* from Nayarit to Sonora, Mexico; and *M. falcatus* from Texas and Colorado. *Notoxus guayanensis* Pic is newly placed in synonymy with *M. schenklingi*, and *Notoxus vianay* Pic is placed as *Incertae sedis* in *Mecynotarsus*. New records for various species are included. *Mecynotarsus balsasensis* Werner was collected in numbers at a cantharidin trap for the first such record for the genus.

Mecynotarsus is currently a large genus of the Notoxinae, containing a rather heterogeneous assemblage of species. Members of the genus are very similar in dorsal aspect, and it appears that several distinct groups have been placed in this taxon due to this convergence in appearance. There is so much difference in the form of the genitalia, wing venation, and shape of the outer edge of the mesosternum, that this group would have been split into a number of genera in the more well-worked Anthicinae (see Bonadona 1974 on the importance of the mesosternal form in the Anthicinae). In this paper two new "groups" of *Mecynotarsus* for the New World are proposed and are distinguished from Werner's (1962) *elegans*-group. These groups are very different from each other and could be considered dissimilar enough to be genera, but until a more complete sample of the world fauna is available, the New World species are left in species-groups. For this reason the genus *Mecynotarsus* is separated from other genera of the Notoxinae only in that its members usually have the metatarsi longer than the metatibiae, the pronotal pits below the cervical angulation reduced or absent, and the setae between the ommatidia of the compound eyes not club-shaped.

Seven very distinctive species, *M. elegans* LeConte, *M. sexnotatus* Champion, and 5 new taxa, were placed by Werner (1962) in his *elegans*-group. He attributed 7 characteristics to the group, of which the most notable are: Setae modified into truncate scales on pronotum and elytra; short, anteriorly directed scales between ommatidia of compound eyes; pronotal horn with 3 large teeth on each side; and elytra inflated. Other characters delimiting the group are: Lateral mesosternal margins straight, only slightly curved near posterior margin (Fig. 1) and lacking pits below cervical angulation of pronotum. Werner noted that the median pair of basal pronotal tactile setae were lacking in this group. These setae are present in species I have seen, but are usually poorly differentiated and may appear to be absent.

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The species of this group are found not only in sandy seashore areas, the classical habitat of the genus, but also in inland areas of desert pavement. New records of *M. balsasensis* Werner indicate that this species occurs in a wide variety of habitats.

Other New World species not included in the *elegans*-group were *M. candidus* LeConte, *M. delicatulus* Horn, and *M. schenklingi* Pic. Werner considered *M. candidus* and *M. delicatulus* to be close to the type of the genus, *M. serricornis* Panzer, while *schenklingi* appeared to be distinct from any of the other known species. Two new groups for the New World are designated in this paper: The *schenklingi*-group, containing *M. schenklingi* Pic; and the *candidus*-group, containing *M. candidus* and *M. delicatulus.*

The *schenklingi*-group is defined as those *Mecynotarsus* with these characteristics: 4 to 6 teeth on each side of horn, no asperities on horn or on underside of head, no keel at middle of horn; lacking median pair of tactile setae at base of pronotum, with pair of lateral tactile setae; head with lateral row of erect flattened setae which outline horn when head is elevated; compound eyes with short aciculate setae between ommatidia, head with scattered scale-like setae; thickened setae covering pronotum and elytra; lacking pits on cervical margin of pronotum; lateral margin of mesosternum straight, with slight curve at posterior margin (Fig. 2); genitalia with phallobase consisting of 3 parts. This species has been collected at the seashore and along the sandy banks of an arroyo (Bruch 1938).

The *schenklingi*-group is most similar to the *elegans*-group in the shape of the mesosternum and the modified setae. The eyes of *schenklingi* lack modified setae, but there are scattered scale-like setae on the head. The only other species with these modified setae are those *Mecynotarsus* from Australia.

The *candidus*-group is characterized by: margins of horn with approximately 8 teeth on each side, conspicuous darkened asperities on horn and underneath head, asperities on horn often forming line between crest and horn margins and usually forming median keel on crest; median pair of tactile setae distinct at base of pronotum, lateral pair of tactile setae present; sides of head lacking setae which outline horn; short, aciculate setae between ommatidia of compound eyes; lateral margin of mesosternum angularly sinuate (Fig. 3); small, nude pits below angulation on cervical margin of pronotum; genitalia with phallobase much longer than parameres. This group is associated with sandy inland and seashore areas of North America.

The *candidus*-group is separated from the species near *M. serricornis* by the form of the horn and the form of the mesosternum. The *candidus*-group has a horn with outwardly bowed sides, the horn margins almost serrate (Fig. 4) and the lateral mesosternal edge angularly sinuate (Fig. 3). *M. serricornis* and a few other Eurasian species have the horn wedge-shaped in outline, with about 6 teeth on each side of the horn, and the mesosternum broadly expanded laterally, almost covering the mesepisternum.

Pic (1912) described *M. schenklingi* from Paraguay and later described *Notoxus guayanensis* from French Guiana (1914) and *Notoxus vianay* from Argentina (1940). I was able to obtain specimens of *M. schenklingi* (identified by H. von Krekich-Strassoldo) and *N. guayanensis* (identified by M. Pic) from the British Museum, and they were found to represent the same species. *N. guayanensis* is here considered a junior synonym of *M. schenklingi.* Pic considered *vianay* to be close to *guayanensis*. F. G. Werner (*in litt.*) examined the type of *N. vianay* and considered it a *Mecynotarsus*. This name is probably a synonym of *M. schenklingi*, but until further proof is obtained, it is here placed as *Incertae sedis* in *Mecynotarsus*. *M. schenklingi* is the only species in the genus recorded from South America.

Members of the *elegans*-group are seldom collected. A recent discovery has been that cantharidin-baited traps are attractive to *M. balsasensis* Werner (Chandler 1976). At Salina Cruz, Oaxaca, such a trap collected hundreds of specimens on the beach, while other collecting techniques were unsuccessful. Hopefully, cantharidin will also be attractive to the other members of the group.

Measurements in the species descriptions are all in millimeters. Total length of a specimen is the pronotal plus elytral lengths. When possible, abbreviations for the collections where specimens are placed are those of Arnett and Samuelson (1969). Other abbreviations used are: DSC, private collection of author; FGW, collection of F. G. Werner, University of Arizona, Tucson; and KSH, K. S. Hagen collection, University of California, Berkeley. The key to species is largely a modification of Werner's (1962) key.

I thank Christine von Hayek of the British Museum (Natural History) for lending me the identified specimens of *M. schenklingi* and *N. guayanensis*. K. S. Hagen of the University of California, Berkeley, T. J. Spilman of the Systematic Entomology Laboratory (ARS, USDA) at the United States National Museum, E. C. Becker of the Canadian National Collection, Ottawa, F. G. Andrews of the California Department of Agriculture, and F. G. Werner of the University of Arizona, Tucson, cooperated with the loan specimens. A Grant-in-Aid from the Society of Sigma Xi aided a collecting trip in Mexico in 1974. I thank Floyd G. Werner, C. A. Triplehorn, and Christine A. Janus for checking the manuscript.

KEY TO THE NEW WORLD SPECIES OF *Mecynotarsus*

1. Setae normal, not thickened or scale-like; median pair of tactile setae present at base of pronotum; more than 6 teeth on each side of horn (*candidus*-group) 2

1′. Setae modified, thickened or scale-like; median pair of tactile setae at base of pronotum lacking or poorly differentiated; horn margins with 6 or fewer teeth on each side 3

2(1). Often with diffuse median darkened area on elytra; west of Rocky Mountains .... *M. delicatulus* Horn

2′. Without median darkened area; east of Rocky Mountains .... *M. candidus* LeConte

3(1′). Horn with 4-6 teeth on each side; setae on pronotum and elytra thickened; South America (*schenklingi*-group) .... *M. schenklingi* Pic

3′. Horn with 3 teeth on each side, setae in form of flattened elongate scales; North and Central America (*elegans*-group) 4

4(3′). Sickle-shaped band of white scales arising from lateral margins in posterior half of elytra, advancing into anterior half of elytra near midline, tips of elytra pale (Fig. 10, 11); Colorado to Texas ..... *M. falcatus,* new species
4′. Bands of white pubescence bar-like or oblique in posterior half of elytra, not proceeding anteriorly into anterior half of elytra 5

5(4′). In dorsal view dark midband of elytra interrupted either along elytral suture or laterally (Fig. 5 & 7) 6
5′. In dorsal view dark midband of elytra not interrupted 7

6(5). Dark midband interrupted along elytral suture (Fig. 7); males with antennomeres IV-VII serrate (Fig. 8); Veracruz ..... *M. alvarado,* new species
6′. Dark midband interrupted laterally (Fig. 5); males with antennomeres V-X flattened and quadrate (Fig. 6); Sinaloa and Nayarit ..... *M. vafer,* new species

7(5′). Patch of dark scales just anterior to elytral apex not or just barely reaching suture 8
7′. Dark scales just anterior to apex forming a broad band across suture 10

8(7). Elytral suture dark in anterior half, interrupted at midline by narrow transverse band; dark mark just anterior to elytral apices a narrow, oblique stripe; Florida to Alabama ..... *M. elegans* LeConte
8′. Elytral suture pale between base and median band; basal half of elytra and disc of pronotum with intermixed brown and white scales 9

9(8′). Dark scales at base of elytra same shade as those in transverse band; posterior dark marking somewhat crescentic, pale zone between it and transverse band also curved; Nuevo Leon ..... *M. intermixtus* Werner
9′. Dark scales at base of elytra much lighter than those in transverse band and posterior dark marks; pale zone between transverse band and posterior marks almost transverse; Jamaica ..... *M. jamaicanus* Werner

10(7′). Scales on elytra so sparse that the pale markings are not obvious in some lights; pale spots on elytra isolated; Guatemala ..... *M. sexnotatus* Champion
10′. Pale pattern very distinct 11

11(10′). Pronotum with brown scales along midline behind crest; Costa Rica ..... *M. nevermanni* Werner
11′. Midline of pronotum with pale scales, flanked by darker scales laterally 12

12(11′). Humeral pale area extending along lateral margins of elytra; southern Mexico ..... *M. balsasensis* Werner

12′. Humeral pale area not extending along lateral margins of elytra; El Salvador and Quintana Roo .... *M. salvadorensis* Werner

Mecynotarsus vafer Chandler, **new species**
(Fig. 5, 6)

Ground color of pronotum fulvous, ground color of elytra anthracine; elytral scales truncate, .04 × .02; scales on pronotum whitish laterally, brownish-orange along midline, 2 pairs lateral setae near base, median basal pair slightly flattened. Elytra with band of brown scales extending from base along suture to middle where expanded, isolated spots of brown scales lateral to point of expansion, spots of brown scales centered in apical third, set off by white scales. Elytra inflated, humeri indistinct. Length 1.74-2.03.

Male holotype: San Blas, Nayarit, MEXICO. Length 2.02. Head 0.46 long, 0.42 wide, eyes 0.11 × 0.10, scales on antennomeres I-II, broad setae on III, V-X flattened and quadrate. Prothorax 0.70 long, 0.34 wide at base, greatest width 0.52 at 0.24 from base, horn 0.28 long, 0.18 wide behind basal pair of tubercles, 3 tubercles on each side and one at apex, crest 0.28 long, 0.08 wide at base, serrate. Elytra 1.32 long, 0.44 wide at base, greatest width 0.78 at 0.44 from base. Metatibia 0.52 long, length metatarsomeres: I 0.24, II 0.16, III 0.12, IV 0.12. Male fifth sternite emarginate, apices of elytra separately rounded. Female similar to male except fifth sternite simple and elytral apices conjointly rounded.

This species has the phallobase not laterally lobiform. Distinct from the others in the group by the different ground color of the pronotum and elytra and the medially centered areas of brown scales.

Distribution: central west coast of Mexico. Holotype male: San Blas, Nayarit, MEXICO, 24/26 April 1961, Howden & Martin, at light. Twenty-two paratypes: 3 males, 1 female, eutopotypical (CNCI, DSC); 3 females, same data except not at light (CNCI, DSC); 1 female same data except, sand dunes (FWG); 1 male, Mazatlan, Sinaloa, 14 August 1969, P. H. Arnaud, Jr., E. S. Ross, D. C. Rentz, near beach (CASC); 7 males, 4 females, sand dunes 8 km N, 16 km W of Guaymas, Sonora, 10 April 1974, D. Giuliani (CDAE). Holotype to be deposited in the Canadian National Collection, Ottawa.

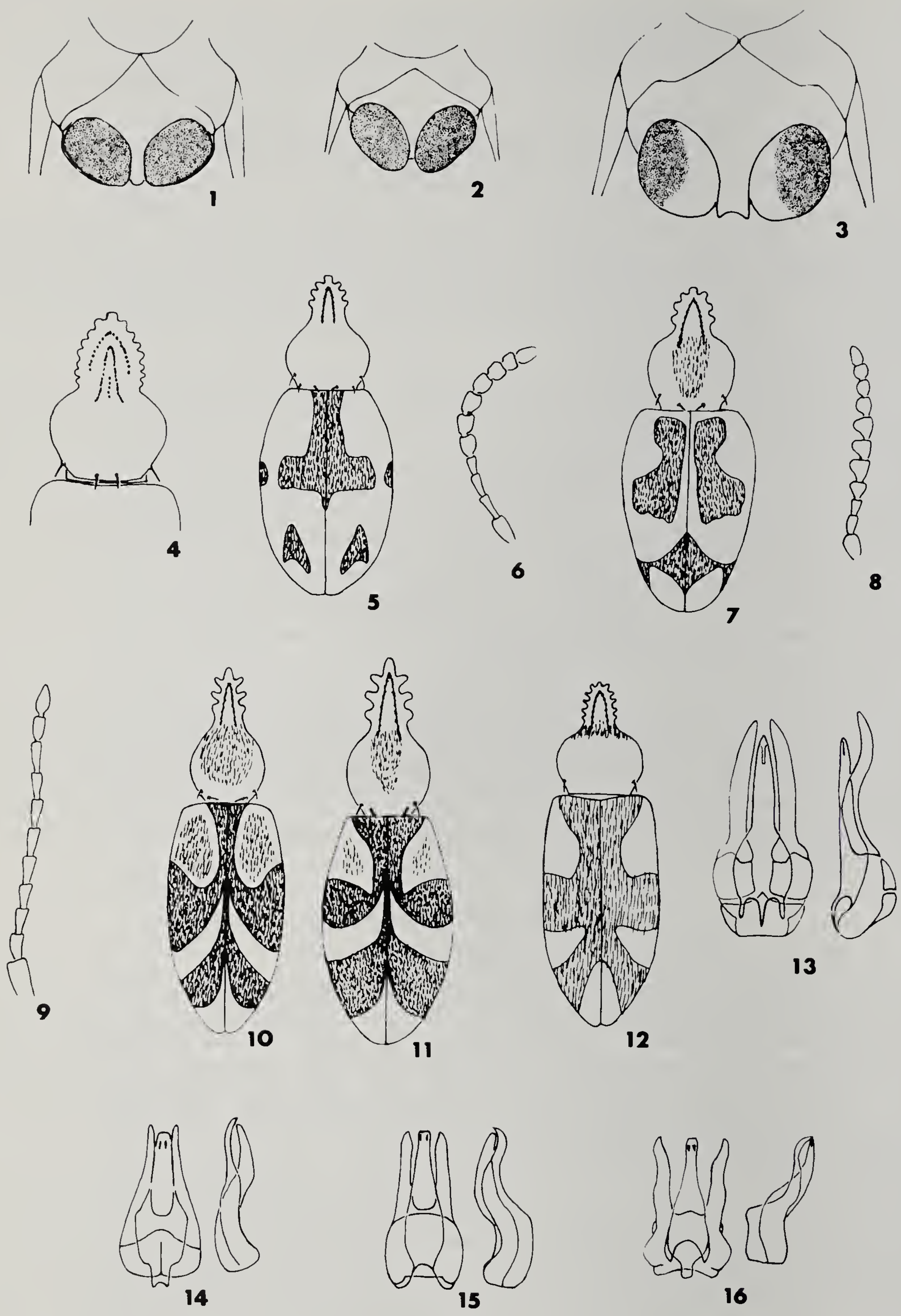
Mecynotarsus alvarado Chandler, **new species**
(Fig. 7, 8)

Ground color of pronotum and elytra brown to fuscous, elytral scales truncate, 0.04 × 0.01, scales on lateral margins of pronotum whitish, becoming brown medially, 2 pairs lateral setae near base, neither flattened. Elytral with brown scales extending posteriorly from base on either side of suture, expanding and usually ending in circular area near middle, spot of brown scales on suture in center of apical half, rarely extending to meet anterior dark areas, set off by white scales. Elytra slightly inflated, humeri distinct. Length 1.74-2.05.

Male holotype: 12 mi NW Alvarado, Veracruz, MEXICO. Length 1.96. Head 0.46 long, 0.39 wide, eyes 0.12 × 0.12, antennomere I with scales at apex, IV-IX expanded laterally at apex, serrate. Prothorax 0.76 long, 0.36 wide at base, greatest width 0.50 at 0.28 from base, horn 0.31 long, 0.22 wide behind basal pair of tubercles, 3 tubercles on each side and one at apex, crest 0.32 long, 0.10 wide at base, serrate. Elytra 1.20 long, 0.44 wide at base, greatest width 0.72 at 0.44 from base. Metatibia 0.50 long, length metatarsomeres: I 0.25, II 0.16, III 0.12, IV 0.14. Male fifth sternite shallowly emarginate, elytral apices separately rounded. Female similar to male except fifth sternite simple, elytral apices conjointly rounded and antennae not so serrate.

Phallobase is not laterally lobiform. Distinct by the elytral pattern and the serrate antennae of the males.

Distribution: beaches in Veracruz. Holotype male: 12 mi NW Alvarado, Veracruz, MEXICO, 25 July, R. L. Mangan & D. S. Chandler, under beach plants. Thirteen paratypes: 8 males, 5 females, eutopotypical (DSC, FGW). The holotype is to be deposited in the United States National Museum.



Figs. 1-3, ventral view of mesosternum: 1) *M. balsasensis*; 2) *M. schenklingi*; 3) *M. delicatulus*. Fig. 4, dorsal view of pronotum of *M. delicatulus*. Figs. 5, 7, 10-12, dorsal view: 5) *M. vafer*; 7) *M. alvarado*; 10), *M. falcatus*, San Diego, Texas; 11), *M. falcatus*, Pueblo, Colorado; 12) *M. schenklingi*. Figs. 6, 8-9, male antenna: 6) *M. vafer*; 8) *M. alvarado*; 9) *M. balsasensis*. Figs. 13-16, ventral and lateral views of male genitalia: 16) *M. schenklingi*; 17) *M. vafer*; 18) *M. alvarado*; 19) *M. falcatus*.

Mecynotarsus falcatus Chandler, **new species**
(Fig. 10, 11)

Ground color of pronotum and elytra ferruginous to fusco-rufous, scales truncate, 0.04 × 0.01, scales on pronotum white on margins, tawny toward midline, 2 pairs lateral setae near base, basal pair shorter and flattened. Elytra with triangular area of white scales behind humeri, mixed tawny and white scales at center of triangular area, sickle-shaped bands of white scales approaching suture, extending anteriorly, apex of elytra with area of white setae along suture, set off by darker ferrugineous to fuliginous scales. Elytra slightly inflated, humeri distinct. Length 1.77-2.32.

Male holotype: San Diego, Texas. Length 1.77. Head 0.38 long, 0.33 wide, eyes 0.09 × 0.09, antennomeres I-VI with scales, broad setae on VII-VIII. Prothorax 0.62 long, 0.28 wide at base, greatest width 0.40 at 0.20 from base, horn 0.26 long, 0.12 wide behind basal pair of tubercles, 3 tubercles on each side and one at apex, crest 0.21 long, 0.04 wide at base, indistinctly crenulate. Elytra 1.15 long, 0.38 wide at base, greatest width 0.63 at 0.48 from base. Metatibia 0.40 long, length metatarsomeres: I 0.20, II 0.12, III 0.10, IV 0.12. Male fifth visible sternite broadly and shallowly emarginate. Female similar to male except fifth sternite simple.

Distribution: Colorado to Texas. Holotype male: San Diego, Duval Co., Texas, 26 May, E. A. Schwarz. Nineteen paratypes: 3 males, 9 females, eutopotypical (DSC, USNM); 1 male, same data except 24 May (USNM); 3 females, same data except, 13 June (USNM); 2 males, 1 female, same data except no date (USNM). Conspecific, not included in type series: El Paso Co.: 1 male, 2 females, El Paso, July, Wickham (USNM). Colorado: Pueblo Co.: 3 males, 4 females, Pueblo, 19 August 1953, G. H. Nelson, on ground (DSC, GHNC, KSH). Crowley Co.: 2 males, Fowler, 15 June 1952, R. S. Beal. The holotype is to be deposited at the United States National Museum.

This species has 2 distinct color forms in the specimens I have seen. The populations from El Paso and Pueblo are dark, the Crowley and San Diego populations markedly lighter. There is a corresponding difference in the area of the lateral origination of the sickle-shaped bands of white scales. In the dark form the band arises in the posterior third of the elytra (Fig. 11) and, in the light form from San Diego, the bands arise near the midline (Fig. 10). The Crowley population, although light, has the bands arising intermediate to these 2 positions. With this information and the knowledge that the genitalia are identical, I have concluded that the 2 forms represent the same species.

Mecynotarsus schenklingi Pic
(Fig. 2, 12, 13)

Mecynotarsus schenklingi Pic 1912, Coleopt. Rundschau 4:54 (Type loc.—Paraguay). Bruch 1938:168-9, Fig. 16.

Notoxus guayanensis Pic 1914, Bull. Soc. Zool. France 39:181 (Type loc.—French Guiana). **New synonymy.**

Distribution: South America. COLUMBIA, Bolivar, Cartagena, Boca Grande, 23 December 1964, R. R. & D. L. Craig (CASC). FRENCH GUIANA: type of *N. guyanensis.* Maroni (BMNH). LESSER ANTILLES: Grenada, 26 January 1936, Sta. 160, R. M. Blackwelder (USNM). BRAZIL: Pará, Santarem (BMNH). Pernambuco, Olinda, Rio Doce, 3 April 1970, A. Pereira; same data except, 24 March 1970, A. Pereira; same data except, 24 March 1970, M. C. Leal (DSC, FGW). PARAGUAY: type of *M. schenklingi.* ARGENTINA: Piquete, Santa Fe (cited in Bruch 1938).

Incertae sedis

Mecynotarsus vianay (Pic), **New combination**

Notoxus vianay Pic 1940, L'Echange-Opuscula martialis I-3, (Type loc.—Argentina).

New Records

Elegans—group

Mecynotarsus elegans: Florida: *Dade Co.,* Biscayne, 1 May, E. A. Schwarz (OSUC); *Palm Beach Co.,* L. Worth (OSUC).

Mecynotarsus balsasensis: MEXICO: *Veracruz*: 12 mi NW Alvarado, 30 July 1975, under plants on beach, D. S. Chandler. *Oaxaca*: Salina Cruz, 3 July 1975, at cantharidin bait, D. S. Chandler (all DSC). *Morelos*; Lago Tequesquitengo, 18 August 1965, M. H. Sweet (TAMU).

Mecynotarsus salvadorensis: MEXICO: *Quintana Roo*; Isla Mujeres, sea beach, 18 January 1966, G. E. & K. E. Ball (FGW). This population has the anterior oblique white bands of the elytra reduced in some specimens. The phallobase of the male genitalia is laterally lobiform.

Candidus-group

Mecynotarsus candidus: Virginia: *Accomack Co.*: 1 June 1972, F. G. Werner & J. F. Burger, sand dune area. New Jersey: *Gloucester Co.*: Westville, 5 May/12 June, H. A. Wenzel. Georgia: *Chatham Co.*: Tybee Island, 28 June/3 July, H. A. Wenzel. New Mexico: *Otero Co.*: White Sands, 12 April 1965, O. W. Richards, on dunes. MEXICO: *Chihuahua*: 48 km S. Juarez, 28 April 1974, D. Guiliani, sand dunes.

Mecynotarsus delicatus: Utah: *Washington Co.*: 6 mi S Hurricane. Nevada: *Churchill Co.*: Carson Sink, 10 mi N. Stillwater: *Esmerelda Co.*: Clayton Valley Dunes. California: *Fresno Co.*: 18 mi SW Mendoza. *Imperial Co.*: Glamis *Inyo Co.*: S end Owens Lake. *Los Angeles Co.*: Pasadena. *Riverside Co.*: Palm Springs. *Sacramento Co.*: Grand Island, sand dunes nr. Isleton. *San Bernardino Co.*: Kelso. *Solano Co.*: Rio Vista. Arizona: *Coconino Co.*: Moenkopi dunes. MEXICO: *Sonora*: sand dunes 8 km N, 16 km W Guaymas; Huatabampito.

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REVIEW OF THE GENUS *PSEUDINDALMUS*, WITH DESCRIPTION OF A NEW SPECIES (COLEOPTERA: ENDOMYCHIDAE)

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ABSTRACT

Seven species, including *Mycetina depressa* Gerstaecker, are redescribed with diagnostic figures. *Ps. javanicus* n. sp. is added. Translations of Pic's descriptions of *Ps. testaceitarsis* and *Falsodanae rufonotata* are included.

Some years ago I was able through a grant from NSF to visit several European museums. Access to type specimens and other courtesies were extended to me by officers of these institutions: J. Balfour-Browne and M. E. Bacchus, British Museum(BM); A. Descarpentries, Paris Museum(PM); and Sven Larsson, Copenhagen Museum(UM). Additionally, I have been able to study material sent by R. D. Pope (British Museum), F. Hieke (Berlin Museum), J. L. Gressitt (Bishop Museum), and A.M.R. Wegner (formerly at Bogor Museum). FSCA refers to Florida State Collection of Arthropods.

Genus *Pseudindalmus* Arrow

Pseudindalmus Arrow 1920a:330. Type species: *Ps. tonkinensis* Arrow.

The species referred to this Oriental genus resemble those of *Mycetina* rather closely. In both genera the pronotum has sides parallel from base to beyond middle, then rapidly and evenly rounded to the short rectangular front angles; lateral sulci broadly triangular, transverse sulcus straight and rather deep; basal margin weakly arcuate and slightly elevated. In *Pseudindalmus* the elytra are 3X or more as long as pronotum, giving the insects a long-oval outline. The antenna has articles 9-10 angularly widened with tendency in males to bulbous enlargement of article 9. Spinasternum prolonged behind front coxae, linguiform, rounded at tip. Intercoxal mesosternum a narrow trapezoid, its very short anterior side normally covered by tip of spinasternum. In *Mycetina* the base of trapezoidal mesosternum is about equal to sides.

From study of aedeagi it appears that the species placed in *Pseudindalmus* may have been derived along 2 or more lines from *Mycetina*, which genus itself, while presenting fairly uniform external features, shows remarkable diversity in form of aedeagus.

Key to species of *Pseudindalmus*

1. Elytron with 1(posterior) orange spot .... (8) *Ps. biguttatus*
1′. Elytron with 2 orange or yellow spots 2

2(1′). Anterior spot not reaching humeral angle 3
2′. Anterior spot touching humeral angle 5

3(2). Entirely black except elytral spots .... (6) *Ps. javanicus*
3′. Pronotum in part reddish 4

4(3′). Head and legs "deep red"(Borneo) .... (3) *Ps. borneensis*
4′. Head and legs black(Singapore) .... (4) *Ps. quadrimaculatus*

5(2′). Venter and legs black .... (7) *Ps. tonkinensis*
5′. Venter and legs red 6

6(5′). Pronotum wholly red .... (1) *Ps. depressus*
6′. Pronotal disc infuscate 7

7(6′). Elytral punctures fine and well-spaced .... (5) *Ps. malaccanus*
7′. Elytral punctures rather coarse and dense .... (2) *Ps. andamanicus*

1. *Pseudindalmus depressus*(Gerstaecker), **new combination**

Fig. 1

Mycetina depressa Gerstaecker 1858:235. Monotype:female from Penang I. (UM).

Pseudindalmus malayensis Arrow 1923:486; Strohecker 1953:pl.4,fig.41. Lectotype(Monotype?):male from Singapore, C.J.Saunders(BM). **New synonymy.**

Under surface, legs, antennomere 1, head, and pronotum red. Elytra black, each with 2 large orange patches. Antenna stout, article 3 longer than wide, following articles each nearly quadrate and progressively wider, article 9 very large, globosely swollen above but concave beneath in male, triangular in female. Elytra closely and rather coarsely punctate, side margin as wide as middle tibia. Length 5-5.5 mm.

A male from Penang I.(FSCA ex Janson) has been closely compared with the monotype of *M. depressa* and conforms entirely with it except in antennal structure and in a slight curvature of the middle tibia. This male is certainly conspecific with *Ps. malayensis.*

2. *Pseudindalmus andamanicus* Arrow

Fig. 2

Pseudindalmus andamanicus Arrow 1920b:33;1925:339,fig.62.

Resembles the preceding rather closely but is a little larger and with narrower elytral margins. Male with antennomere 9 inflated, front trochanters spiniform, and front tibia bluntly toothed near base. Length 5-6 mm.

Lectotype:male from Andaman Is., Roepstorff(BM). Paralectotypes: 5 males, 6 females with same data as lectotype(BM;FSCA).

3. *Pseudindalmus borneensis* Arrow

Fig. 6

Pseudindalmus borneensis Arrow 1920b:34.

". . . rather smaller than [*Ps. tonkinensis, Ps. andamanicus*] and more glossy, the elytra especially being much more finely punctured. The head and legs are deep red in the type specimen and the pronotum is bright red in front but becomes gradually darker towards the base. The elytra are less broadly rounded at the sides than in *P. tonkinensis*—with less conspicuously flattened margins. In the male the ninth joint of the antenna is larger than the 10th, but scarcely as large as the 11th. Length 5 mm, width 2.5 mm."

Monotype: male from Sabah: Sandakan, C. F. Baker(BM). I have identified 2 females as this species: S. O. Borneo, Grabowsky(Berlin); Sarawak: Serikei Distr., Rajang Delta, VII-1958, T. C. Maa(Bishop).

4. *Pseudindalmus quadrimaculatus*(Pic), **new combination**

Fig. 5

Mycetina IV-maculata Pic 1930:9.

The head and legs of the type are blackish; otherwise the description of *Ps. borneensis* fits it closely. The aedeagus in both species is a long, slender, undulant tube. Extreme similarity suggests conspecificity but additional material will be needed for such a decision.

Monotype: male from Singapore(PM).

5. *Pseudindalmus malaccanus*(Pic), **new combination**

Fig. 3

Mycetina malaccana Pic 1930:9.

Venter, legs, head, and front and sides of pronotum red. Elytra black with usual 2 pale patches on each; anterior spot touches humeral angle, and its front edge runs mesad and back at an angle of 45° with base; surface conspicuously but not coarsely punctate. Male with antennomere 9 enlarged, with outline of a right triangle but somewhat bulbous above; hind tibia weakly curved and abruptly widened beyond middle. Length 4.5-5 mm.

Monotype: female from Singapore (PM). Two males, 4 females taken at Singapore by C. J. Saunders are in BM.

6. *Pseudindalmus javanicus* Strohecker, **new species**

Fig. 4

Black, strongly shining, tarsi reddish, each elytron with 2 orange patches, anterior spot behind umbo, almost touching flattened margin but remote from suture, posterior spot on caudal slope. Antenna of male 2.3 mm long, articles 3-5 each slightly longer than wide, 6-8 about as wide as long, 9 triangular, somewhat enlarged, 10 transversely triangular, 11 suborbicular but slightly truncate. Pronotum finely, elytra thickly and conspicuously but not coarsely punctate. Length 5.4-6, width 2.8-3.4 mm.

Holotype: male from Java: Preanger, Tankoeban Prahoe, 4000-5000 Voet, VI-1933, F. C. Drescher (Leiden Museum).

Allotype: female with same data except taken X-1933 (Leiden).

Paratypes: 5 males, 2 females from Tankoeban Prahoe, VI-XI-1933, F. C. Drescher and II-1938, R. W. Becking (FSCA; BM). A considerable series was returned by me some years ago to Bogor Museum determined as *Ps. depressus.*

7. *Pseudindalmus tonkinensis* Arrow

Fig. 7

Pseudindalmus tonkinensis Arrow 1920a:331; 1928:353.

Larger and of broader form than any of the preceding species and with sides of elytra more arcuate, side margins narrow. Entirely black except 4 orange elytral spots. Antenna stout, each of stalk articles nearly or quite as wide as long, article 9 of male enlarged and roundly produced mesad at apex, that of female about equal to 10, each of these with outline of right triangle. Pronotum with marginal bead thickened and slightly reflexed, narrower toward front; disc shining, finely punctate. Elytra finely punctate, interspaces much wider than a puncture. Anterior spot touching humeral angle, its front edge inclined meso-caudad at 45° angle to base. Length 6-7, width 3.5-3.7 mm.

Lectotype: male from Laos: Haut Mekong, Muong Sing, 18-IV-1918, R. V. de Salvaza (BM). Pic (1929:35) cites co-types in Vitalis collection. Viet Nam: Annam, Dalat, 29-III-1924, R. V. de Salvaza, 2 males (BM); Tonkin, VI-17, R. V. de S., female (BM); Dalat, 29-IV/4-V-1960, S. & L. Quate, male, female (Bishop; FSCA). Laos: Vientiane area, Ban Van Eue, Mar. 1966, female (Bishop).

8. *Pseudindalmus biguttatus* Strohecker

Fig. 8

Pseudindalmus biguttatus Strohecker 1939:120.

Ventral surface, legs, antennomere 1, head, and pronotum red. Elytra deep black, each with large, quadrate orange patch between middle and apex, patch only narrowly separated from margin and suture. Entire insect strongly shining as though lacquered, much flattened. Punctures of pronotum and elytra extremely fine and widely separated. Antenna stout, article 3 somewhat longer than wide, other stalk articles progressively shorter, article 9 (male) weakly swollen, convex above, flattened below. Front tibia of male widened from base to beyond middle, thence inner edge shallowly excavate to apex. I have seen only the (Mono) type. Length 7, width 3.7 mm.

Monotype male from Sangir I. (FSCA ex Janson).

Taxa dubia

Although Pic noted the types of the following 2 species were in his collection, neither Descarpentries nor I succeeded in finding them. Both types were ascribed to Tonkin.

Pseudindalmus testaceitarsis Pic

Pseudindalmus testaceitarsis Pic 1926:10; 1929:3; Arrow 1928:353.

Oblong, shining, minutely and sparsely punctured, black, tarsi testaceous, elytra with reddish-yellow band at shoulder and behind, anterior patch external and rather wide, second discoidal. Differs at first sight from *Ps. tonkinensis* Arrow by the testaceous tarsi and different elytral markings. Length 5 mm.

Synonymized with *Ps. tonkinensis* by Arrow (1928:l.c.) but this action protested by Pic (1929:l.c.), who proposed for it the subgenus *Mycetinina* of *Mycetina*. The "regularly enlarged" antennal club would seem to displace it from *Pseudindalmus*.

?Pseudindalmus rufonotatus (Pic)

Falsodanae rufonotata Pic 1940:11.

Oblong-elongate, shining, red, disc of pronotum infuscate, elytra black, with reddish-yellow patch at shoulder and behind middle, legs red; pronotum transverse; elytra somewhat elongate, sides slightly subarcuate and broadly margined, apex attenuate; tibiae simple, hind tibiae not ciliate. Length 5-5.5 mm.

According to Pic's generic description, antennomere 9 is strongly dilated in male, simple and slightly transverse in female. Although Pic placed *Falsodanae* near *Danae* on the basis of male antennal structure, he noted pronotal similarity to that of *Pseudindalmus,* to which genus I assigned it in my catalogue (1953:96).

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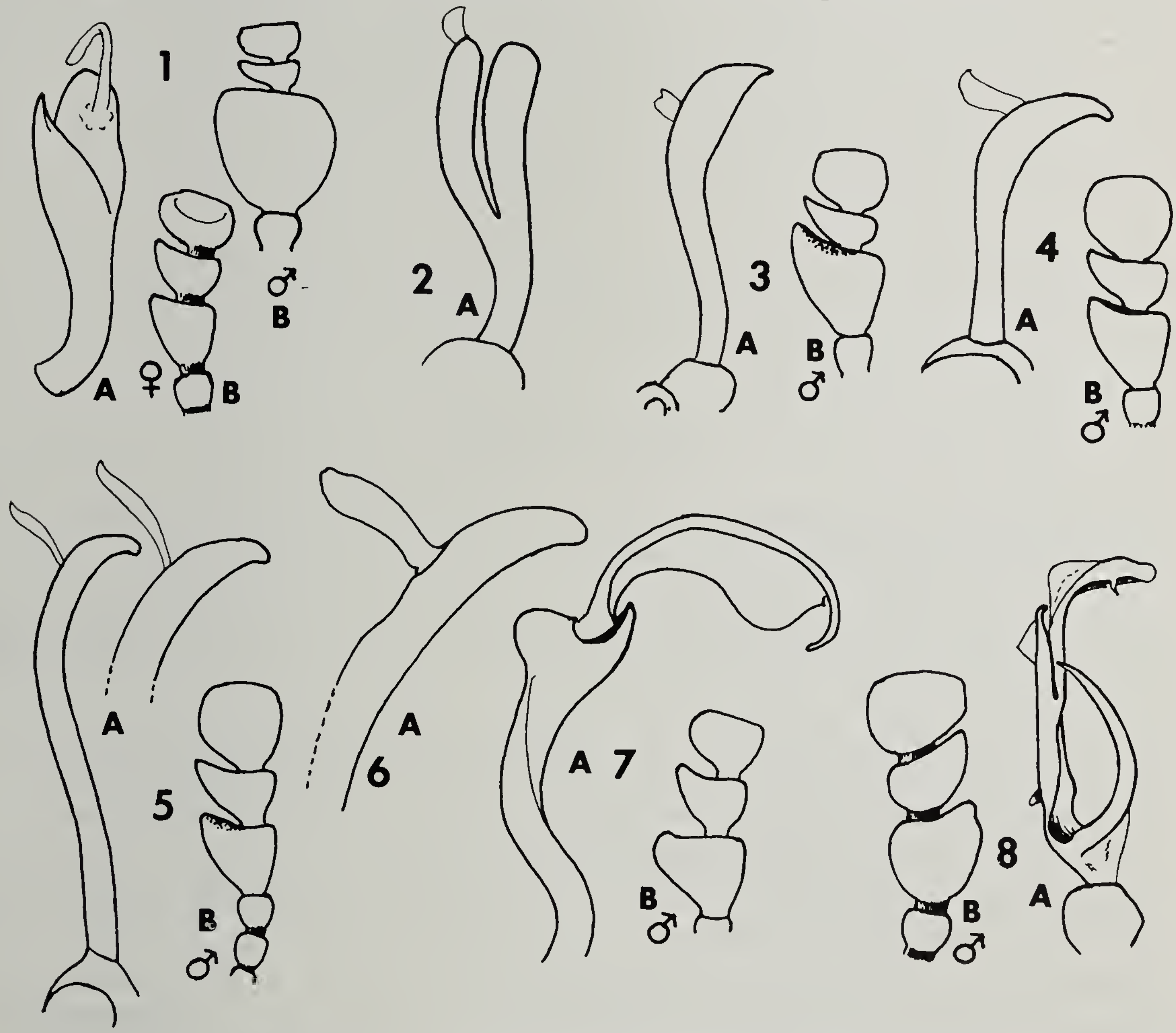

Figs. 1-8. A) aedeagus, ventral face except 8A, right side. B) antennal club, right except 8B, left. 1) *Pseudindalmus depressus* (Gerst.)—topotype. 2) *Ps. andamanicus* Arrow—lectotype. 3) *Ps. malaccanus* (Pic)—topotype. 4) *Ps. javanicus* n.sp.—holotype. 5) *Ps. quadrimaculatus* (Pic)—monotype. 6) *Ps. borneensis* Arrow—monotype. 7) *Ps. tonkinensis* Arrow—lectotype. 8) *Ps. biguttatus* Strohecker—monotype.

BOOK REVIEW

Insect clocks, by D. S. Saunders. 1976. Pergamon Press, Inc., Maxwell House, Fairview Park, Elmsford, N.Y. 10523. Hardbound, 280p., $18.50.

Saunders has done a good job of reviewing the recent literature and outlining the available information on insect clocks. It is a comprehensive study of "those phenomena in which 'environmental time' has a functional significance in the life of insects, enabling them to perform behavioural or physiological events at the 'right time' of the day, month, year or tide." The first 3 chapters probably will be of most interest to the majority of the members of The Coleopterists Society—(1) Introduction: Rhythms and clocks, (2) Circadian rhythms of activity in individual insects, and (3) Circadian rhythms of activity in populations of insects. Most of the remaining 7 chapters should be of interest to those conducting research in the area of insect physiology. At the end of each chapter is an annotated summary of the major concepts covered. The first part of the Appendix includes a very useful glossary and a list of symbols which are used to describe clock phenomena. Tables 1 and 2 in the Appendix should be of special interest to the entomologist. These tables provide information on the rhythms of activity exhibited by individual insects and by populations of insects (15 species of Coleoptera are included). Approximately 700 references help to make this volume a worthwhile contribution to entomology.

—Paul P. Shubeck

BOOK NOTICES

Animal population ecology, by J. P. Dempster. 1975. Academic Press, 111 Fifth Ave., N.Y., NY 10003. Hardbound, 156p., $10.00.

The insect integument, edited by H. R. Hepburn. 1976. North-Holland, Amsterdam, and Elsevier Publishing Co., 52 Vanderbilt Ave., N.Y., NY 10017. Hardbound, 572p., $63.50.

Insect development, edited by P. A. Lawrence. 1976. Halsted Press (Div. of John Wiley & Sons, Inc.), 605 Third Ave., N.Y., NY 10016. Hardbound, 230p., $25.00.

Insects and history, by J. L. Cloudsley-Thompson. 1976. St. Martin's Press, Inc., 175 Fifth Ave., N.Y., NY 10010. Hardbound, 242p., $18.95.

The ethology of predation, by E. Curio. 1976. Springer Verlag New York, Inc., 175 Fifth Ave., N.Y., NY 10010. Hardbound, 252p., $29.60.

Animal agents and vectors of human disease, 4th ed., by E. C. Faust and P. C. Beaver. 1975. Lea & Febiger, 600 S. Washington Sq., Phila., PA 19106. Hardbound, 143p., $11.75.

Evolution of desert biota, edited by David W. Goodall. 1976. Univ. of Texas Press, P. O. Box 7819, Austin, TX 78712. Hardbound, 250p., $12.95.

—Paul P. Shubeck

THE COLOR PHASES OF *THINOPINUS PICTUS* LECONTE (COLEOPTERA: STAPHYLINIDAE)

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Abstract

Thinopinus pictus LeConte ranges from Baja California to southern Alaska. It is polytopic in the northern half of its range. *T. variegatus* Motschulsky is a synonym, not a subspecies.

The large seashore insect, the pictured rove beetle *Thinopinus pictus* LeConte, was considered by Leng (1920) as having 2 subspecies: The typical pale adult form described by LeConte from San Diego, California (1852) and a northern subspecies *T. pictus variegatus* Motschulsky (1853), with dark adults, described from "Littoral occidental de l'Amerique". Motschulsky's material all came from Russian America, i.e., north of San Francisco. Essig (1926) wrote of it, "It ranges along the Pacific Coast from Lower California as far north as Central California. On the white sand near Monterey, E. C. Van Dyke reports a very pale form, while the darker form *variegatus* (Mots.) ranges from Central California to Southern Alaska."

Until recently all adult specimens seen by me from north of Monterey County, California were definitely darker than those seen from Monterey County and south. I assumed that 2 subspecies were involved. Moore and Legner (1976), in a chart giving distribution of some Pacific Coast seashore Coleoptera, treated them as distinct subspecies. However, with respect to collecting adults on various beaches in Oregon, Malkin (1958) stated, "The interesting feature of this was the fact that every specimen belonged to the relatively scarce melanistic form in which dark body color is very dominant over the usual, yellow, pale color. The beach here is made up of black and dark volcanic sand. On the other hand, the pale, yellow form lives on light colored white or yellow beaches and what is interesting here is the very rigid restriction of each form to the appropriate type of beach background." I thought that these 2 color forms to which Malkin referred were varieties of the dark northern subspecies.

Recently, with assistance by Loren Russell, I have been able to borrow from Dr. John D. Lattin, Oregon State University, Corvallis, a series of 67 specimens of the pale form from Oregon. These were taken in May, June, and July at Charleston, Oregon. They differ in no discernible way from the pale forms from southern California and Baja California. Therefore, *Thinopinus pictus* LeConte 1852 = *T. variegatus* Motschulsky 1853, **new synonymy.**

Dark forms seen by me come from Rockaway Beach, San Mateo County, California; Dillon Beach, Sonoma County, California; Bainbridge Island, Kitsat County, Washington; and near Neah Bay, Callum County, Washington. Malkin mentions taking the dark form at Mountain State Beach, Curry County, Oregon and lists a number of Oregon beaches which support the pale form. These northern records of the pale form with records of the melanistic form to the south of them definitely establish that no geographic subspeciation exists. Only one species is involved, it being polytopic in the northern part of its range.

This polytopic distribution is, no doubt, induced by the color of the sand on which the insects live. This species is wingless. Craig (1970) gave an account of its habits. Its wingless condition must greatly impede dispersal and consequently limit gene flow along the coast so that selection by predators causes the population of each individual beach to closely resemble the color of the sand on which it lives. Leech and Moore (1971) discussed flights of *Cafius* and related beetles at the seashore and hinted that such flights were probably of a dispersal nature. Such strong fliers as *Cafius* show no color adaptations to individual beaches. This further strengthens the conception that the color phases of *Thinopinus pictus* are due to its flightless condition and consequent selection for color to match the environment.

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* * *

A NEW SPECIES OF MELOIDAE (COLEOPTERA) FROM MALAYSIA

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Abstract

A new species of blister beetle, *Zonitoschema gombakiensis,* is described from Malaysia.

The genus *Zonitoschema* Peringuey (1909) has not been recorded previously from Malaysia. It is represented there by the following new species.

I thank R. B. Selander for critical reading of the manuscript.

Zonitoschema gombakiensis Mohamedsaid, **new species**

Description. Body length from frontal suture to apices of elytra 13.0 mm; color yellowish. Head 2.0 mm long, 1.1 × as wide as long, widest across eyes; cephalic outline triangular; sides above eyes arcuate; punctures large, dense; pubescence short, dense. Eyes large, on upper side approximate, with interocular region 1/3 as wide as eyes, on under side subcontiguous; anterior margin deeply emarginate opposite antennal insertion. Antennae filiform, very long; segment I-II light brown, rest dark brown; II short, 0.7 × as long as, narrower than III; IV-X subequal, arcuate, narrower than III; V reaching base of pronotum; XI fusiform, 1.8 × as long as III. Clypeus narrowed to apex; basal region with punctures as on head; apical region smooth, sparsely pubescent. Labrum longer than wide, depressed at middle, apical margin densely clothed with brushlike hairs. Mandibles long, curved, black at apices. Maxillary palpi (Fig. 1) with segment III-IV dark brown, moderately dense with short pubescence. Maxillary galeae prolonged in front of mandibles, with pencillate hairs at apices. Labium (Fig. 2) deeply emarginate; mentum oval, longer than wide; labial palpi with apical segment dark brown. Pronotum 2.2 mm long, 1.1 × as long as wide, campanuliform, shiny; sides subparallel; anterior margin barely curved; posterior margin flared, reflexed; punctures and pubescence as on head. Scutellum triangular, base twice as wide as apex; pubescence short, sparse. Elytra elongate, subparallel, surface densely covered with small punctures and short pubescence. Legs long, slender, dark-brown except for basal part of tibiae, and femora; tibial spurs similar to each other, spiniform; tarsal claws with upper blade thick and 2 rows of pectinations, one row shorter than the other, the lower blade thin, smooth. Ventral surface densely covered with short pubescence.

Male. Fifth visible abdominal sternum deeply emarginate. Sixth visible abdominal sternum (Fig. 3) cleft nearly to base. Pygidium (Fig. 4) deeply emarginate. Genitalia as in Figs. 5-8; aedeagus without hooks; gonoforceps with apical piece cleft, the basal piece sinuate on both apical and basal margins.

Type-material. Holotype, male, MALAYA: Gombak, 22-III-63, G. C. Sanderson, at light, in the collection of R. B. Selander, University of Illinois.

Remarks. This species is distinguished from *Zonitoschema ennsi* Kaszab (1958) [=*Zonitis phlippinensis* Pic (1944)], described from Philippines, in having the eyes very close to each other on both the upper and lower sides, and the thorax campanuliform and densely punctate.

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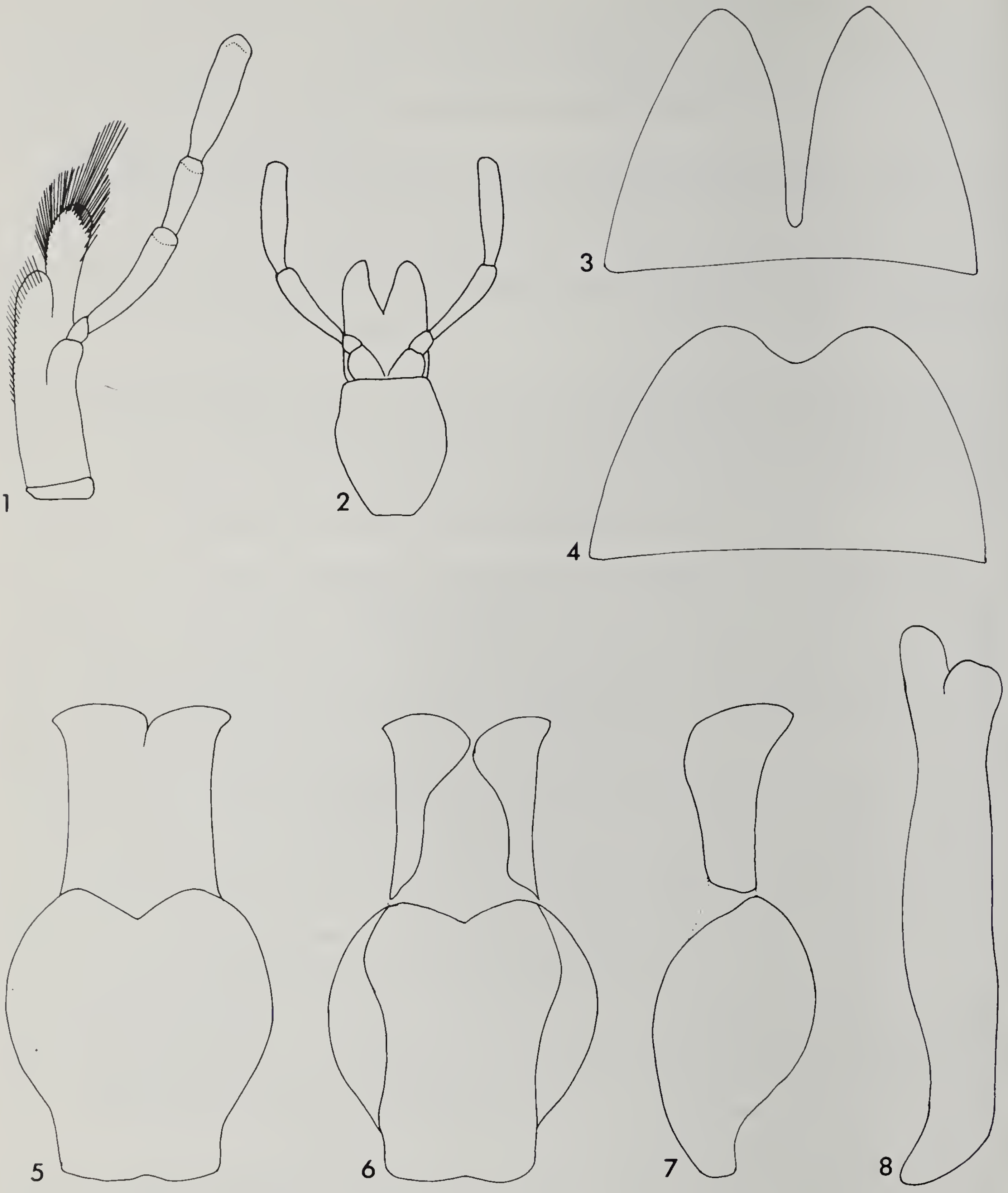

Figs. 1-8, *Zonitoschema gombakiensis*: 1, Maxilla; 2, Labium; 3, Sixth visible abdominal sternum; 4, Pygidium; 5, Gonoforceps, dorsal view; 6, Gonoforceps, ventral view; 7, Gonoforceps, lateral view; 8, Aedeagus, lateral view.

COLEOPTERISTS NEWSLETTER

(C. W. O'Brien, editor)

TECHNIQUE FOR THE STUDY OF IMMATURE COLEOPTERA IN GLYCERINE

The study of larvae has always been impaired by problems with techniques. Generally specimens are studied either in a solution of alcohol or mounted in Canada balsam. Studies in alcohol do not yield much information on chaetotaxy and microsculpture and it is hard to study the specimen in temporary fixed positions because the liquid lacks viscosity and the specimen floats about. In Canada balsam more details are obtained, but the position of the specimen is permanently fixed. More recently the critical drying point technique offered an excellent method for studying a rare larva, especially under SEM. Despite these techniques, studying larvae remains slow and difficult, especially if one tries to work at the species level with populations. Moreover, it is obvious that larvae must be studied at high power (100 to 500x) to yield large numbers of characters, including small ones. This can be easily achieved with SEM, but at what price when one works with populations!

The best and least expensive alternative is the study of cleared specimens at low power through a stereo or compound microscope. In the following method one can not only have the resolution of balsam-mounted specimens but also can study any angle with nearly as much ease as with adults. Indeed, I can study 20 species with as many as 20-50 samples with up to 10 small larvae per sample. The basic principle of the method is to clear the larval tissues in KOH, then to impregnate them with glycerine (glycerol) and to study them on a ring slide in glycerine. I use ring slides that are prepared by gluing 2-4 mm thick rings of stable material (plastic or stainless steel) or aluminum (satisfactory if specimens are not stored on slides) to slides. Aluminum rings are easily made on a metal lathe. In my work with medium-sized Carabidae, my rings were 22 mm. in external diameter to match the cover slips. For gluing rings to the slides I prepare a dilute solution of Canada balsam in xylene, then wet one side of the ring and place it on the slide, then let it dry overnight on the slide warming table.

After specimens have been impregnated with glycerine, their handling is nearly as easy and fast as with adults. The positioning is easier than with adults and is faster at low power as no cover slips are necessary. This method works best for prognathous larvae that are at least slightly sclerotized. The best specimens are straight, but curved specimens can be straightened in the glycerine. If you want to insure straight larvae, kill them in near boiling water and leave them there for about five minutes. After study, larvae can be stored in glycerine vials; this is not permanent storage, but is good for at least 2 to 10 years. If specimens are stored in alcohol, they must be reimpregnated with glycerine if studied again.

COLEOPTERISTS NEWSLETTER, cont.

Method:

1. Take specimen(s) from alcohol (cleaning them if very dirty) and place them in gently boiling 10% KOH for 3-5 minutes. Large larvae, 10 mm or more, should be punctured at 1-3 spots ventrally.
2. Transfer specimen(s) into distilled water. For all my work I used a staining or solid watch glass with a polished concave surface. This shape is crucial during the evaporating process later on. As bodies collapse easily, in this and remaining steps I use an eye-dropper with a large enough opening to handle the specimen.
3. Change the water three times. Never remove all of the water to avoid collapsing the specimen(s).
4. Prepare a 4% solution of glycerine. Fill the watch glass, then put the specimens in.
5. Let the water evaporate in a dust-free place (I use a drawer) for about three days. Better still, put on a microscope slide warming table at 50-60°C overnight. Insure that specimens are in the lowest part of the watch glass before you leave them.
6. Transfer the specimens to a ring slide with an eye dropper. The ring is then filled to the top with glycerine. If you work at low power (100-300x), specimens can be studied without a cover slip. At higher power I position the specimens with fine forceps under a stereo dissecting microscope, then cover with a cover slip.

The results can be spectacular if absolute cleanliness is maintained throughout the whole procedure.

Henri Goulet
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NOTICE

The *Cooperative College Register* has been re-established as a communications link and matching service for positions and position-seekers for higher education. Write for details. Cooperative College Register, 621 Duke Street, P. O. Box 298-A, Alexandria, VA 22314.

COLEOPTERISTS NEWSLETTER, cont.

COLEOPTERISTS AT C.S.I.R.O.

E. B. Britton has retired from his position as Curator of Coleoptera for the Australian National Insect Collection, C.S.I.R.O., Canberra. He will continue to live in Canberra and will carry forward some of his personal research projects.

Dr. Britton has been succeeded by J. F. Lawrence, formerly of the Museum of Comparative Zoology, Harvard University.

Other members of the staff on Coleoptera are E. C. Zimmerman, Curator of Weevils, T. A. Weir, and W. Allen. B. P. Moore works part time on Carabidae, and P. B. Carne part time on Scarabaeidae.

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REORGANIZATION OF THE COLEOPTERA DEPARTMENT AT THE "PARIS MUSEUM"

Due to a reorganization in the department of Coleoptera because of the approaching retirement of Mrs. Bons, the responsibilities of personnel have been apportioned in the following manner:

A. Villiers, Professeur, Chef du Départment: Cerambycidae, Disteniidae, Languriidae.
R. Dajoz, Maître de conférences: Cucujoidea (except Bostrychidae, Languriidae, Coccinellidae and Endomychidae).
A. Descarpentries, Maître-Assistant: Buprestidae, Scarabaeidae *s. l.*
J. Menier, Maître-Assistant: Malacodermoidea, Cleroidea, Dascilloidea (except Buprestidae and Elateridae), Bostrychidae, Scolytidae, and Platypodidae.
Mlle. N. Berti, Assistante: Chrysomelidae, Coccinellidae, Endomychidae, and Staphylinoidea *s.l.*
Mlle. H. Perrin, Assistante: Curculionoidea, Adephaga *s.l.*
Cl. Girard, Attaché C.N.R.S.:Heteromeroidea *s.l.*, Elateridae.

You are asked to correspond directly with the individual responsible for the section of your interest or, in case of uncertainty or difficulties, to write directly to Mr. A. Villiers.

Jean J. Menier
Museum National d' Histoire
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Laboratoire d' Entomologie,
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Robert E Woodruff acting managing editor

PS Form 3526 *(Page 1)*
Apr. 1976

(See instructions on reverse)

Notice to Authors

Manuscripts will be considered from any authors, although those from members of the Coleopterists Society are given priority. It is suggested that all prospective authors join the Society. All manuscripts should conform to instructions in the **Style Manual for Biological Journals** (3rd Ed.) prepared by the Committee on Form and Style of the Conference of Biological Editors, and published by the American Institute of Biological Sciences, 2000 P Street NW, Washington, DC 20063.

The following exceptions are noted: 1) all geographical names are to be spelled out, 2) use words, not symbols, for male and female, 3) use numerals throughout, except to begin a sentence, 4) entomology, -ical, -ist, etc. are to be abbreviated Ent. in literature citations.

Specimen label data should be listed in the following manner: MEXICO: State of Veracruz, Fortin de las Flores, 10-VIII-70, I. B. Jones, under bark of **Pinus moctezumae,** 7000ft. [USNM] (2). The number in parentheses indicates the number of specimens. Geographical names are listed in order with largest units first, with states, departments, provinces, parishes, and/or counties listed. Dates are listed by day, month (in Roman numerals), and last 2 digits of the year. Listing of ecological data is encouraged. Location of specimens should be shown in brackets; if the data are extensive these should be abbreviated as shown and the abbreviations listed in the text.

Any article concerning Coleoptera will be considered. Descriptions of new taxa must contain keys (or be correlated with existing keys) and illustrations. All manuscripts should be typed on 8½×11" opaque white paper with 1 inch margins. They should be typed on one side only and double spaced throughout (including title, footnotes, tables, figure legends, and references). All scientific names should be underlined. Use the following order: title, author, author's address, abstract, body of text, references cited, and figures. All footnotes, tables, and figure legends should be provided on separate sheets and double spaced. Indicate approximate figure and table locations in pencil in the margin of the manuscript.

An abstract is required for all articles longer than 2 manuscript pages. It should be a concise statement of the facts presented, not *that* they are presented (e.g., list actual conclusions derived from a discussion). This abstract is the key to how your article will be cited in abstracting journals and should be carefully written.

For the author's protection as well as for the editor's convenience, manuscripts should be submitted in duplicate. Manuscripts will be processed most rapidly if the authors have had them critically reviewed in advance; such critical reviews minimize the probability of rejection or major revision.

THE COLEOPTERISTS SOCIETY

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Notices to appear on this page are a free service to members and subscribers. Such copy will be limited to the back page; the older notices being moved up and replaced with the newest ones at the bottom. The editor reserves the right to reword such notices for brevity, consistency, and clarity.

SCARABAEIDAE: Working toward a general revision of the Anomalinae of Mexico, Central, and South America. Specimens and records needed by loan, purchase, or exchange. Identifications by arrangement. Robert W. L. Potts, California Acad. Sci., Golden Gate Park, San Francisco, CA 94118.

CHRYSOMELIDAE (ALTICINAE): Reworking manuscript revision of the maculate species of *Phyllotreta* of the U. S. and Canada for publication (includes the normally immaculate *P. denticornis*, *P. decipiens*, and *P. d. ordinata*). Request loan of such material immediately. Eric H. Smith, Division of Insects, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605.

MELOIDAE: Revising the genus *Gnathium* (Nemognathinae). Request loan of specimens from all areas, Mexican material being particularly welcome. Wilbur R. Enns, 1-87 Agriculture Building, University of Mo., Columbia, MO 65201.

DETERMINATIONS DESIRED: Blacklight trap operated year-round in Puerto Rico. Advise your interest, and if it appears I will send it to you in 70% alcohol in return for mounting and ID. You keep duplicates. H. L. Murphy, Calle 21 Sur #0-1, Bayamon Gardens, Bayamon, PR 00620.

SCARABAEIDAE: For sale or trade—specimens of *Goliathus cacicus, G. regius,* and occasionally *G. atlas* and *G. albosignatus*; wanted—other African Cetoniinae and Lucanidae. Write for prices and specific desiderata. Chris Adamson, 2437 Warring #G, Berkeley, CA 94704.

PEDILIDAE: Revising North American species of *Pedilus*. Request loan of determined and/or undetermined larvae and adults from any area. Also interested in bionomics of group, correspondence welcome. Daniel K. Young, Dept. Ent., Michigan State Univ., East Lansing, MI 48824.

CICINDELINAE CATALOGUE WANTED: Coleopterorum Catalogus #86, W. Horn, 1926. H. Boyd, Oak Shade Rd., Tabernacle Twp., RD 4, Vincentown, NJ 08088.

CERAMBYCIDAE: Need *Derancistrus* spp. from all areas for study. Will buy or exchange. Julio Micheli, 14 Baldorioty Str., Mariani, Ponce, PR 00731.

AVAILABLE FREE: Werner, Enns, Parker, "The Meloidae of Arizona", TB 175 (1966) and Butler & Werner, "Distrib. and Host Plants of May Beetles in Arizona", TB 147 (1961). Floyd G. Werner, Dept. Ent., Univ. Arizona, Tucson, AZ 85721.

FOR SALE: First class well preserved colorful insects and butterflies, many hundreds of species and subspecies. Small or big order accepted; will send by air mail to your home. Peter Andersen, Global Colosseum, 67 Spottiswoode Park Rd., Spore 2, SINGAPORE.

EXCHANGE: Wanted—North and Central American Dytiscidae, Gyrinidae, Dryopidae, Elmidae, Heteroceridae, Haliplidae. Offered—species from Central Europe. Witold Wiezlak, 04-607 Warszawa, Trawiasta 29 b, POLAND.

FOR SALE: Melolonthinae—very rare *Euchirus dupontianus* at $150/pair, postpaid airmail. Assorted Asian Coleoptera $100/box. Mrs. Zenaida Jardiniano, Nepomuceno Street, Boac, Marinduque 3801, PHILIPPINES.

PSEPHENIDAE (PSEPHENINAE, EUBRIINAE, EUBRIANACINAE, PSEPHENOIDINAE): Revising for world. Request loan of specimens from all areas. Harley P. Brown, Zoology Dept., Univ. Oklahoma, Norman, OK 73019.

HYDROPHILIDAE WANTED: Preserved in isopropyl-carnoy (3:1 isopropyl to glacial acetic acid) for chromosome analysis. Will exchange other families similarly preserved. Stan Malcolm, Box U-43, Biol. Sci. Grp., Univ. of Connecticut, Storrs, CT 06268.

CERAMBYCIDAE: Buy, exchange all species from neotropical region, especially from Central America; ask for list. Dr. K.-E. Hüdepohl, Brunnenhof, D-8134 Aschering, West Germany.

WANTED: Carabus, Calosoma, Cychrus, Scarabaeidae, Cerambycidae in exchange for same or other families from Austria, Belgium, France, Germany, Italy. Maurizio di Leo, Via Corsica #1, 40135 Bologna, Italy.

TENEBRIONIDAE: Wanted—literature from South America, for purchase or in exchange for named specimens; wanted—specimens from Patagonia, Andes Range, and arid areas of South America for study. Luis E. Pena G., P.O. Box 2974, Santiago, Chile.

FOR SALE: 5m × 2.5 m linear MALAISE TRAPS. Collecting heads utilize cyanide and/or alcohol. Proven design used world wide. Additional information & prices write D. A. Focks, P. O. Box 12852, Gainesville, FL 32604.

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FOR SALE: R. C. L. Perkins, David Sharp, & others, Fauna Hawaiiensis, 1910, Vol. I-III complete, bound, excellent condition, with many original descriptions, $400. E. J. Ford, Jr., 103 South Gay Street, Room 517, Baltimore, MD 21202.

WANTED: Coleopterorum Catalogus #71 A. Zimmermann, #79 A. Knisch; On aquatic carnivorous Coleoptera or Dytiscidae by D. Sharp; British water beetles vols. I, II by F. Balfour-Browne. Sh. Hosseinie, Dept. Biol., College of Arts & Sciences, Pahlavi University, Shiraz, IRAN.

ILLUSTRATIONS: Accurate habitus drawings enhance any taxonomic paper, but many authors have neither time nor talent to do their own. I have both, available for a reasonable charge. Accuracy, satisfaction guaranteed. M. C. Thomas, 2867 NE 7th St., Apt. D, Ocala, FL 32670.

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